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HISTORY

OF THE

IMPROVED (M50) HONEST JOHN ROCKET SYSTEM (U)

1954—1965

S E C U R I T Y

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HISTORY OF THE IMPROVED (M50) HONEST JOHN ROCKET SYSTEM (U)

1954—1965

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23 August 1965

Historical Monograph
Project Number: AMC 7 M, Part II

[redacted]

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(U) PREFACE

(U) In the spring of 1950, the Ordnance Corps initiated a priority research program with the object of developing a large-caliber, free-flight rocket for use as a direct-support atomic weapon carrier to supplement conventional field artillery cannon. From this crash development program emerged the Honest John family of 762-mm. free-flight artillery rockets which have been the mainstay of U. S. and NATO ground combat forces for well over a decade. The Basic (M31) Honest John Rocket System was deployed in 1954 as the first U. S. tactical nuclear weapon. Seven years later, in 1961, the Improved (M50) Honest John Rocket System reached the field, along with the smaller 318-mm. Littlejohn Rocket System. Originally known as the Honest John Junior, the Littlejohn began as an integral part of the Honest John project in 1953-54, but was established as a separate Ordnance Corps project in 1955.

(U) This monograph traces the evolution of the Improved (M50) Honest John System from its inception in late 1954 to mid-1965. It is the second volume to be published on the Honest John family, the first covering the Basic M31 Rocket System (1950 - 1964). Monograph coverage of the unique "John" family of artillery rockets will be complete with the publication of a third volume dealing with the Littlejohn system.

(U) Unless otherwise noted, the footnotes are unclassified. File locations are indicated for all source documents except those contained in Historical Division files, U. S. Army Missile Command.

23 August 1965 Mary T. Cagle

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CHAPTER I

(U) ORGANIZATION AND MANAGEMENT

(U) The ultimate success of any weapon system development program depends in large measure upon adherence to the basic principles of economy and good management. The weapon system manager must have adequate authority and responsibility to supervise, direct, and control his program. The program objectives must be clearly defined and realistically planned. Decisions must be firm and timely. Financial support must be prompt and adequate. Elaborating upon these principles, Maj. Gen. John G. Zierdt, now Commanding General of the U. S. Army Missile Command, once said:

> . . . [One] of the prime conditions to successful system management . . . is the need for localized control of [the] program. . . . Control must be immediate and local, otherwise the transition from one phase of research and development to the next is always a bumpy one because there is insufficient local knowledge of where that system has been, where it is going, and when it is supposed to get there.
>
> Another prime condition which influences the effectiveness of management is the absolute necessity of establishing a goal, committing the authority and resources necessary to its realization, and then having the good sense to leave that part of the effort alone.
>
> . . . [Our] inability to obtain solid decisions is . . . the most singularly damaging influence and is the most difficult to cope with in any current missile endeavor. I call it "Stop-Start Philosophy." It permeates program funding, technical decision, and in fact every phase of system activity. Since the days of Newton and Watt and Franklin, society has . . . promoted science from the ranks of things to be tolerated to a level of near adoration. Yet, in applying science to our defense needs, we continue to ignore a simple basic rule of management economy which surely even Adam understood, the absolute necessity of establishing a goal, then stepping back and permitting the capable party charged with this responsibility to arrive at the desired solution. . . .[1]

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[1] Speech (while Colonel and Commander of the ARGMA) to the DOD R&E Policy Council Meeting at Ft Monroe, Va., 6-8 Jul 60, sub: Managing a Major Missile System R&D Program.

(U) The doctrine used in the prosecution of the Honest John program was built around a dilatory, stop-start philosophy that flew in the face of both management economy and the high priority, crash nature of the program. For 8 consecutive years, essentially covering the 1950-58 period, administration of the program floundered without coherent guidance, without responsive management controls, and without clearly defined command channels. Program funding and planning fluctuated from one extreme to the other. There were frequent program reviews, re-evaluations, and reorientations. The system manager spent an inordinate amount of time justifying and rejustifying his program to an increasing number of committees.

(U) The present discussion is limited to an assessment of basic weaknesses in the general management structure and their impact on the efficiency of operations. Problems and delays relating to program funding and planning are treated in a separate chapter.

(U) Roles and Missions of Redstone Arsenal

(U) When the initial Honest John studies began in 1950, the Ordnance Corps missile program was still operating at a relatively low level. Starting with one project in 1944, the Department of the Army had five in 1945. By 1950, the number of programs had been reduced to four, which the Department of the Army was supporting at an annual cost of about $36 million.[2] Technical control and supervision of these few projects had been performed by an organization centralized in the Office, Chief of Ordnance (OCO). But the rapid expansion of Ordnance missions beginning in 1950 dictated a radical change in management doctrine and a more elaborate management structure.

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[2] Raymond J. Snodgrass, "Ordnance Guided Missile Program, 1944 - 1954," (Hist Br, OCO) pp. 30-31. Draft of MS in Hist Div Files.

(U) Realizing that the Ordnance Corps facilities then operational would not be able to handle the projected volume of work, the Chief of Ordnance had reactivated the Redstone Arsenal at Huntsville, Alabama, on 1 June 1949.[3] In performing its new mission as the Ordnance Rocket Center, this World War II manufacturing arsenal was to conduct basic and applied research, development, and testing of free rockets, solid propellants, jato (jet-assisted takeoff) units, and related items; administer R&D contracts placed with resident contractors[4]; exercise technical supervision over R&D projects, as assigned; and keep abreast of all scientific and technological developments in the rocket field.[5] One of the first major in-house tasks undertaken by the new Rocket Center was the preliminary design study of the special-purpose rocket later designated as the Honest John. This study, it will be recalled, was assigned to the Arsenal in late May 1950, and the Douglas Aircraft Company began the engineering design study in October of that year.[6]

(U) Meanwhile, the Arsenal's mission was expanded to include research and development in the field of guided missiles. To provide adequate facilities for this new mission, the adjoining Huntsville Arsenal, which had been inactivated by the Chemical Corps, was acquired by the Ordnance Corps and consolidated with the Redstone Arsenal effective 1 April 1950.[7] Two weeks later, the Ordnance Guided Missile Center was established in the old Huntsville Arsenal headquarters.[8] The guided missile group, headed by Dr. Wernher von Braun, completed the move from

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[3] DA GO 39, 18 Aug 49.

[4] The Rohm & Haas Company and the Thiokol Corporation had signed contracts earlier in the year to staff and operate Government-owned R&D facilities within the Arsenal.

[5] Ord Dept Order 25-49, 18 Jul 49.

[6] See Mary T. Cagle, History of the Basic (M31) Honest John Rocket System, 1950 - 1964 (Hist Div, MICOM, April 1964), pp. 19-20, 23-28.

[7] DA GO 19, 14 Jun 50.

[8] RSA GO 1, 15 Apr 50.

Fort Bliss, Texas, in October 1950. The Arsenal's new mission in the field of guided missiles included component and systems development in aerodynamics, guidance and control, propulsion, assembly techniques, transport, test, and launching.[9]

(U) With the rocket and guided missile research programs thus combined in a central location, maximum use could be made of the German scientists skilled in these fields and further economies could be effected through the elimination of duplicate or parallel efforts. But the Redstone Arsenal Commander still had not been delegated the authority and responsibility needed to function as a true commodity center. Specifically, he needed greater responsibilities in overall program coordination and increased authority over closely allied phases of the program, such as industrial and field service activities.[10]

(U) Of prime concern during the early 1950's was the lack of clearly defined communication channels for coordination of program activities among the divisions of the OCO and the various field commands. Personnel having the most experience and information on the overall program were in the Rocket Branch of the Research and Development (R&D) Division, OCO, but their interest was limited primarily to R&D activities. As a result, the industrial, field service, and training elements did not receive the guidance and attention essential in the early phases of such a radically new and complex product. Adding to the confusion was the relatively new crash program procedure, whereby these hitherto, historically distinct phases of weapon system development were telescoped to shorten the time from conception to availability in the hands of troops. With the complexity of modern weapons making program acceleration more and more difficult, improved communication and liaison throughout the Ordnance

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[9] ARGMA Hist Sum, 1 Apr - 30 Jun 58, pp. 8-9.

[10] (1) Ibid., pp. 9-10. (2) Memo, Lt Col William J. Durrenberger, to Maj Gen Alfred B. Quinton, Jr., OCO, 5 Feb 51, sub: Coord of the Ord Effort in the GM Prog.

Corps structure was essential. Referring to the coordination problems that existed in early 1951, Lt. Col. William J. Durrenberger warned: "The importance of the guided missile program to the future of the Ord Corps can hardly be overemphasized, and with the program being expedited as it is, we in Ordnance are going to have to move fast if we are to meet our responsibilities in this field."[11]

(U) One of the first steps to improve program coordination and control was the formation of an Ordnance Guided Missile Organization and Training Committee which held its initial meeting on 24 January 1951. This meeting not only pointed up potential problem areas, but also demonstrated certain management weaknesses that had existed since inception of the guided missile program. For example, it was the first gathering at which key representatives of all Ordnance Corps guided missile activities were present, and many of these individuals had never contacted one another previously, even though the Corps had been in the guided missile business since 1944. As originally conceived, the mission of this committee was limited to organization and training matters. However, the first meeting showed that much could be gained by broadening the mission to include coordination of all the guided missile functions being performed or contemplated by the Ordnance Corps. This committee was regarded only as an interim solution to existing problems and was to be dissolved when sufficient experience had been accumulated to permit the establishment of normal channels within the existing Ordnance structure.[12]

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[11] (1) Ibid. (2) In July 1951, Colonel Durrenberger transferred from the OCO to the Redstone Arsenal where he continued to fight the coordination problem, first as Director of Projects (August 1951 - September 1952) and then as Assistant Director of the Ordnance Missile Laboratories (September 1952 - May 1953). RSA SO's 151, 1951; 222, 1952; and 117, 1953.

[12] Memo, Lt Col W. J. Durrenberger to Maj Gen Alfred B. Quinton, Jr., 5 Feb 51, sub: Coord of the Ord Effort in the GM Prog.

(U) The establishment of such channels turned on the delegation of additional responsibility and authority to the Redstone Arsenal so that it could properly and efficiently operate as a true Ordnance commodity center for guided missiles. The responsibility for coordination and technical supervision of the Honest John rocket program—then in the engineering design and feasibility study stage—had been transferred from the OCO to the Redstone Arsenal in late December 1950.[13] This was followed in the early months of 1951 by the assignment of national mission responsibilities for industrial and field service functions; however, the responsibility for both technical supervision and technical control of guided missile development programs still rested with the R&D Division, OCO. After a thorough study of the problem, Colonel Durrenberger recommended, in early February 1951, that the responsibility for technical supervision of these R&D programs be transferred to the Redstone Arsenal as expeditiously as possible, and that such transfer be accompanied by three or four selected individuals to effect a more equitable distribution of the limited supply of qualified technical personnel. He also recommended that personnel training in the use of new Ordnance equipment be accelerated.[14]

(U) Nearly 5 months later, in June 1951, the Chief of Ordnance announced the transfer of responsibility for R&D technical supervision of two guided missile projects (Nike Ajax and Corporal) to the Redstone Arsenal effective 16 August 1951.[15] Other projects were transferred on a piecemeal basis over the next several years. Meanwhile, Col. Carroll

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[13](1) MFR, John W. Womble, HJ Proj Engr, RSA, 19 Dec 50, sub: Ord Proj TU2-1007D, Trip Rept - Visit to WSPG and DAC, 11-14 Dec 50. HJ R&D Case Files, Box 14-9, RHA AMSC. (2) Ltr, CofOrd to Dist Chf, LAOD, 15 Jan 51, sub: Appr of Awd - DAC. ORDTU File, Jul 50 - May 51, FRC.

[14](1) Memo, Lt Col W. J. Durrenberger to Maj Gen Alfred B. Quinton, Jr., 5 Feb 51, sub: Coord of the Ord Effort in the GM Prog. (2) Also see Ord Corps Order 10-51, 26 Feb 51.

[15]Ltr, CofOrd to CO, RSA, 26 Jun 51, sub: Trf of R&D Resp to RSA.

D. Hudson, then Commander of the Arsenal,[16] established the organizational framework to implement his assigned national missions. Officially activated on 6 August 1951 were (1) the Field Service Division, comprising the Redstone Depot and the National Stock Control and National Maintenance Points; (2) the National Procurement Division; and (3) the Technical and Engineering Division, which embraced the rocket and guided missile development functions of the former Ordnance Rocket and Ordnance Guided Missile Centers.[17]

(U) The Provisional Redstone Ordnance School was organized at the Redstone Arsenal on 3 March 1952, with Colonel Hudson serving as Commandant in addition to his duties as Arsenal Commander.[18] The school remained an integral part of the Arsenal mission and organization until 1 December 1952, when it was redesignated as the Ordnance Guided Missile School (OGMS), a Class II activity located at the Redstone Arsenal and operated under jurisdiction of the Chief of Ordnance.[19] Effective 1 July 1953, the OGMS and other training activities at Ordnance installations were placed under jurisdiction of the Army Ordnance Training Command, a Class II activity located at Aberdeen Proving Ground, Maryland.[20] The Ordnance Corps did not publish definitive guidance with respect to new equipment training responsibilities of

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[16] Colonel Hudson remained in command until 7 May 1952. He was succeeded by Brig. Gen. Thomas K. Vincent who served until 31 August 1954. Brig. Gen. (later Maj. Gen.) H. N. Toftoy was in command from 1 September 1954 to 31 March 1958, when the new Army Ordnance Missile Command was formed. (1) RSA GO's 16, 16 Jun 52; and 43, 1 Sep 54. (2) AOMC GO 2, 31 Mar 58.

[17] RSA GO 5, 3 Aug 51.

[18] RSA GO 5, 3 Mar 52.

[19] DA GO 17, 16 Feb 53.

[20] DA GO 60, 11 Aug 53.

commodity managers until August 1953.[21]

(U) During the 1952-55 period, the Arsenal's mission activities underwent expansion and realignment. In September 1952, the functions of the Technical and Engineering Division were absorbed by the newly created Ordnance Missile Laboratories.[22] The National Procurement Division was expanded to include industrial engineering and related functions, and redesignated as the Industrial Division effective 1 January 1955.[23] This was followed, on 7 February 1955, by the creation of the R&D Division, which assumed responsibility for that part of the mission of the Ordnance Missile Laboratories formerly assigned to the Technical and Engineering Division.[24] The Ordnance Corps published detailed mission statements for the Redstone Arsenal and other key commodity arsenals and commands in June 1955.[25]

(U) Three years later, on 1 April 1958, the Arsenal's technical missions (i.e., those of the Ordnance Missile Laboratories and the Field Service, Industrial, and R&D Divisions) were transferred to the new Army Rocket and Guided Missile Agency (ARGMA), a subordinate element of the Army Ordnance Missile Command (AOMC).[26] In the AOMC

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[21](1) Ord Corps Order 30-53, 27 Aug 53, sub: Tng in Maint & Op of New Type Ord Equip. (2) For a complete background history of the Arsenal's training mission and related problems, <u>see</u> ARGMA Semiannual Hist Sum, 1 Jul - 31 Dec 60, pp. 14-25.

[22]RSA GO 24, 18 Sep 52.

[23]RSA GO 71, 8 Dec 54.

[24]RSA GO 25, 16 Feb 55.

[25]Ord Corps Orders 15-55 and 19-55, both dated 1 Jun 55 and effective 1 Jul 55. <u>See</u> Supplement to RSA Semiannual Hist Sum, 1 Jan - 30 Jun 55.

[26](1) Ord Corps Order 6-58, 31 Mar 58. (2) Ord Corps GO 8-58, 1 Apr 58. (3) For further detail on the Arsenal missions and organizational background <u>see</u> ARGMA Hist Sum, 1 Apr - 30 Jun 58, pp. 1-23. (4) <u>Also see</u> Cagle, <u>History of the Basic (M31) Honest John Rocket System, 1950 - 1964</u>, pp. 124-25.

mission realignment of 1 August 1960, commodity management responsibility for the Honest John and certain other surface-to-surface weapon systems was transferred from the ARGMA to the Army Ballistic Missile Agency (ABMA).[27] On 11 December 1961, both the ARGMA and the ABMA were abolished and their functions absorbed into the AOMC headquarters.[28] After 31 July 1962, the AOMC was known as the U. S. Army Missile Command.[29]

(U) Division of Responsibility and Authority

(U) Throughout the early 1950's, the Redstone Arsenal Commander was severely handicapped by the lack of adequate authority to direct and control his assigned national missions without interference from higher headquarters. The problem stemmed from weaknesses in the Ordnance Corps' organizational structure which one Corps historian aptly described as "a complex arrangement with many ramifications involved in carrying out the various functional responsibilities."[30] The OCO organizational pattern followed functional lines down to division level and a mixture of both functional and commodity lines at subordinate levels. Similar patterns existed in the organizational framework of field installations and of field offices which were considered as extensions of the OCO. To provide specialized staff assistance to the field, the Chief of Ordnance charged his key mission divisions with Ordnance-wide staff supervision of functions in their respective areas. For example, the R&D, Industrial, and Field Service Divisions exercised staff supervision over their respective counterparts

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[27] AOMC GO 59, 27 Jul 60.

[28] DA GO 47, 26 Dec 61.

[29] MICOM GO 5, 30 Jul 62.

[30] Raymond J. Snodgrass, Organization and Management of the Ordnance Corps, 1945 - 1958 (OCO, July 1958), p. 70.

at the Redstone Arsenal and other field commands. This assignment did not prevent direct access by the Arsenal Commander to the Chief of Ordnance on questions of policy and matters of major importance.[31] However, the divided authority and responsibility prevented effective management controls at the local level and created much confusion.

(U) In keeping with the trend toward maximum decentralization, and in view of the limited personnel, space, and funds at the headquarters level, the Chief of Ordnance pursued a policy of centralized control and decentralized operations. He delegated authority to the field commands for actual performance of operations so long as this did not impede essential control over policy or the standardization of procedures. Major field commands, comprising the intermediate level of management, were assigned mission responsibilities largely on a commodity basis.[32]

(U) In April 1951, President Truman requested that the executive departments of the government review their programs and operations to insure that sufficient authority had been delegated for effective operation at field level. "Successful management," he asserted, "must be accomplished by responsible officials in the field. It will not be achieved if those officials are hampered by inadequate delegation of authority from their central headquarters. . . ."[33] In response to a subsequent inquiry from the Army Chief of Staff, the OCO defended the existing policy, pointing out that the limitations on field commands were largely the result of limitations prescribed by higher Army echelon or by the Chief of Ordnance in the interest of effective management controls.[34]

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[31]Ibid., pp. 69, 73.

[32]Ibid., pp. 70, 73.

[33]Ltr, Harry Truman to Heads of Executive Depts and Agencies, 24 Apr 51, copy in OHF. (As cited in ibid., p. 71.)

[34]Cmt 2, Col E. S. Gruver, Exec Off, OCO, to COA, 16 Jul 51, sub: Delegations of Authority, O.O. 020/116. (As cited in ibid., p. 71.)

(U) These limitations were reflected in the authority delegated to the Redstone Commander for management of major rocket and guided missile projects. In general, the responsibilities delegated to the Arsenal in 1951 were restricted to technical supervision of specifically assigned projects, the power of overall technical control being retained by the R&D Division, OCO. In the case of the Honest John, Nike Ajax, and Corporal projects, for example, the Arsenal Commander monitored, coordinated, and conducted the technical aspects of the programs in his assigned capacity as "the sole source of instruction" to project contractors.[35] The R&D Division, OCO, exercised general direction and control of the programs, with responsibility for rendering final decisions in matters relating to "policy, scope, and objectives of the project," as well as the "original approach and major changes in the design, performance and operation of the missile." Recognizing the potential problems inherent in such an arrangement, Brig. Gen. Leslie E. Simon, then head of the R&D Division, wrote:

> This division of responsibility necessitates that the closest possible liaison be maintained between Redstone and the operating Branches of this office. This is particularly emphasized because of the semi-vertical organizational structure for guided missiles within the Ordnance Corps resulting from the designation of Major General Quinton as alter ego of the Chief of Ordnance for Guided Missiles. It is necessary therefore that ORDTU have more immediate access to information concerning guided missile projects than is required in any other field of research and development.[36]

(U) In the wake of growing confusion and conflict between the

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[35] This meant, in effect, that the R&D Division, OCO, would no longer deal directly with the contractors, but would channel instructions through Redstone. The Honest John files are replete with obvious violations of this procedure; yet the Arsenal Commander invariably bore the brunt of the responsibility when something went wrong.

[36] Ltr, O.O. 682/159 to CO, RSA, 26 Jun 51, sub: Trf of R&D Resp to RSA. (This letter was primarily concerned with the Nike and Corporal projects, but the same division of responsibility applied to all other projects assigned to the Redstone Arsenal, including the Honest John. See footnote 13 above, and OTCM 33836, 2 Aug 51.)

primary and secondary management levels, the Chief of Ordnance, in September 1952, issued a detailed policy directive for the purpose of defining the functional responsibilities involved in the prosecution of R&D projects "in order to facilitate the complete understanding of all concerned."[37] Obviously aimed at existing problems in management control and coordination, this order divided the various functions in four distinct categories; namely, policy direction and control, technical control, technical supervision, and contract negotiation, execution, and administration. The division of responsibility relating to technical control and supervision remained essentially the same as outlined above; however, the new directive was much more explicit and it gave the R&D Division more latitude for redelegation of certain authority to the field.

(U) The responsibility and authority for policy direction and control was delegated to the Chief, R&D Division, OCO. Duties in this category embraced the selection of the general approach to be followed; determination of priorities and the scale of effort to be applied; establishment of target dates; coordination with related projects or sub-projects and with other interested agencies; preparation of engineering test programs; and acceptance or rejection of final prototype designs.

(U) The Chief, R&D Division was also assigned the responsibility for technical control of all R&D projects with "authority to re-delegate Technical Control of entire projects or sub-projects to the field." (The latter authority was rarely exercised; and it was in these functional areas that most of the confusion and bottlenecks occurred.) Technical control included these important functions: (1) selection of potential contractors; (2) determination of the scope of contracts; (3) approval of technical decisions affecting cost, completion date,

[37]Ord Corps Order 43-52, 29 Sep 52, sub: Resps for R&D Projs.

and priority of competing military characteristics (MC's); (4) approval of proposed solution for satisfying the desired MC's; (5) determination of the validity of proposed solutions in terms of the established basic design data; (6) delineation of technical supervision delegated to another agency or agencies; and (7) delineation of the areas of interest of mission arsenals jointly concerned with the prosecution of the project.

(U) The responsibility for technical supervision of R&D projects fell to the field installations. In general, the functions in this area were concerned with assisting, advising, and directing the project contractors; establishing contacts with agencies qualified to contribute to the projects; and making routine technical and administrative decisions.[38]

(U) The broad scope of authority centralized in the Office, Chief of Ordnance, and the guarded reluctance to redelegate such authority to the field, illustrates the extent of limitations actually imposed on the installation commander. Apparently aware of this situation, Secretary of the Army Frank Pace, Jr., remarked, in October 1952, that the Ordnance Corps' policy of partial decentralization had possibly resulted in some confusion and delays because of divided authority and responsibility. He argued that the Corps had not achieved the potential benefits of true decentralization and suggested that its organization "may be subject to improvement."[39]

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[38] Ibid.

[39] Memo, Frank Pace, Jr. for CofS, USA, 16 Oct 52, sub: Organization, Ordnance Corps, attached to DF, Exec Off, OCO, to ACofS, G-4, 20 Mar 53, sub: Request from Office, Deputy Under Secretary of Army, O.O. 020/18. (As cited in Snodgrass, Organization and Management of the Ordnance Corps, 1945 - 1958, pp. 5, 45.)

(U) At the behest of Secretary Pace, Lt. Gen. Williston B. Palmer, then the Assistant Chief of Staff, G-4, made a brief study of the Ordnance Corps' organizational structure and procedures, in late 1952. In summing up his analysis, General Palmer indicated that there was little basically wrong with the existing structure. He pointed out that after World War II the Ordnance Corps had been deflated by executive and congressional policy and that in 1950 a small group of officers had to undertake an immense expansion. "This close-knit group of officers," he concluded, "runs the Ordnance Corps with understanding and vigor. . . . Their machinery is running soundly and is in no danger of collapse." He further concluded that, while the Corps' organization and procedures were confusing to the outsider, better acquaintance showed that most of the confusing effect stemmed from the "vastness of the Ordnance activities and the difficulty Ordnance officers have in explaining to an outsider what is perfectly clear to themselves."[40] An analysis of the actual program management structure, however, reveals that the root of the prevailing confusion and frustration ran much deeper than that.

(U) The organization and management of the Honest John program during the 1950-54 period is a case in point. The development and procurement of this weapon system required the talent and technical know-how of many Government agencies which worked more or less independently on various phases of the program under the overall direction of the OCO. Aside from the Redstone and Rock Island Arsenals, which had primary and, perforce, overlapping mission assignments, there was a host of supporting agencies and contractors. These activities were scattered from one end of the country to the other, operating under splintered

[40](1) Memo, Lt Gen W. B. Palmer for CofS, 18 Dec 52, sub: Organization of Ordnance Corps, attached to DF, Exec Officer, OCO, to ACofS, G-4, 20 Mar 53, O.O. 020/18. (2) DF, Lt Gen W. B. Palmer, ACofS, G-4, to COA, 25 May 53, sub: Management Survey of the Ordnance Corps, G-4 file 25930. (As cited in Snodgrass, op. cit., pp. 45, 47.)

responsibility and authority, and without a responsive system of central coordination and control.

(U) The weapon system program actually consisted of two separate projects: TU2-1029, relating to development of the complete missile, was assigned to the Redstone Arsenal; TU2-3008, taking in the launcher and all items of ancillary equipment except the wind measuring set (a Signal Corps item), was the responsibility of the Rock Island Arsenal. Each of these arsenals had responsibility for exercising technical supervision of R&D and procurement work in its assigned area, and each reported directly to the OCO. Redstone's responsibility was much broader, however, in that it was charged with the awesome task of coordinating the activities of all agencies engaged in the program, with the OCO exercising technical control and overall coordination.[41] (See Table 1.)

(U) Such a task would have been extremely difficult of accomplishment even with adequate delegation of authority. As it was, the Redstone Commander carried the burden of responsibility, while divisions in the OCO controlled and directed the program, generally working at cross-purposes and very often usurping the responsibility and authority supposedly delegated to the Arsenal. Although considerable progress had been made toward solving the liaison problems that existed early in 1951, Colonel Durrenberger noted, in December 1952, that there were still some key administrators "who paid only 'lip service' to the importance of coordination."[42] Personnel of the loosely controlled divisions in the OCO cut across established command lines and dealt

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[41](1) OTCM's 33836, 2 Aug 51; 34118, 28 Feb 52. RSIC. (2) Ltr, O.O. 471.94/567, CofOrd to CO, RSA, 31 Aug 51, sub: Large Cal Fld Rkt, HJ. HJ R&D Case Files, Box 14-8, RHA AMSC. (3) Ltr, O.O. 471.94/758, CofOrd to CO, RIA, 13 Nov 51, sub: Lchg & Hdlg Equip for HJ, Proj TU2-1029, Pri 1A. HJ R&D Case Files, Box 14-90, RHA AMSC.

[42]Memo, Lt Col W. J. Durrenberger, Asst Dir, OML, to Brig Gen. H. N. Toftoy, Dir, OML, 12 Dec 52, sub: Coord of the GM & Rkt Progs.

Table 1—List of Agencies and Contractors Engaged in Honest John Project

Name of Agency or Contractor	Area of Interest or Cognizance
Redstone Arsenal, Huntsville, Ala.	
Rocket Development Division	Technical supervision rocket development; trailer-type launcher development; launcher engineering studies; rocket-launcher compatibility.
Technical & Engineering Division	Preparation formal specifications, drawings; compilation field service data; technical aspects production engineering.
National Procurement (Industrial) Division	Procurement of complete missile, less warheads; supervision of industrial contractors.
Purchasing & Contracting Branch	Contract administration, Resident Contractor (Thiokol Corp.)
Field Service Division	Stock control, storage, surveillance, maintenance, and issue of Honest John rocket, less certain warheads.
Office, Chief of Ordnance	
Rocket Branch, R&D Division (ORDTU)	Technical Control/Coordination, weapon system development.
Artillery Branch, R&D Division (ORDTR)	Fire Control.
Ammunition Branch, R&D Division (ORDTA)	Warheads.
Ammunition Branch, Industrial Division (ORDIM)	Rocket production.
Artillery Branch, Industrial Division (ORDIR)	Launcher production.
Field Service Division (ORDFX)	Field service.
Rock Island Arsenal, Illinois	Design, development, and procurement of self-propelled launcher and ancillary equipment.
Frankford Arsenal, Philadelphia, Pennsylvania	Fuze development.
Picatinny Arsenal, Dover, New Jersey	Warhead development; Jato cycling tests.
Radford Arsenal, Virginia (GOCO: Hercules Powder Co.)	Production/Loading, Main Jato.
Raritan Arsenal, Metuchen, New Jersey	Publications.
White Sands Proving Ground, New Mexico	Flight test program.

Table 1 - Continued

Name of Agency or Contractor	Area of Interest or Cognizance
Army Chemical Center, Maryland	Warhead development.
Sandia Corp./Armed Forces Special Weapons Project, Sandia Base, New Mexico	Special warhead development.
Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland	Ballistic Tables; Effectiveness studies.
Naval Ordnance Test Station, China Lake, Calif.	Spotting Charge loading.
Ordnance Ammunition Center, Joliet, Illinois	Rocket procurement control.
Signal Corps	Meteorological equipment (Wind Measuring Set).
Corps of Engineers	Dust alleviation equipment.
National Bureau of Standards, Washington, D. C.) Corona Laboratories, Corona, California)	VT Fuze development.
Army Field Forces Board No. 1, Ft Sill, Oklahoma	User tests.
Los Angeles Ordnance District, Pasadena, Calif.	Contract administration (Douglas Aircraft Co.)
New York Ordnance District, New York, N.Y.	Contract administration (Burnham Corp. and AMFCo.)
Philadelphia Ordnance District, Philadelphia, Pa.	Contract administration (ACF-Brill Motors Co.)
Douglas Aircraft Co., Santa Monica, California	Prime contractor, Rocket & Trailer Launcher development; First Rocket Production Contract.
Burnham Corp., Irvington, New York	Prime Contractor, R&D Jato manufacture.
Allegany Ballistics Lab., Cumberland, Maryland	Development of main Jato.
M. W. Kellogg Co., Jersey City, New Jersey	Manufacture of R&D Jato metal parts.
Thiokol Corp., Redstone Div., Huntsville, Ala.	Propellant development & loading, Spin Rocket.
ACF-Brill Motors Co., Philadelphia, Pennsylvania	Engineering study on lightweight launcher.
American Machine & Foundry Co. (AMFCo), N.Y., N.Y	Engineering study on full trailer launcher.

SOURCE: (1) "List of Agencies and Contractors Involved with Honest John Project," Rkt Dev Div, RSA. HJ R&D Case Files, Box 14-9, RHA AMSC. (2) Also see Cagle, History of the Basic (M31) Honest John Rocket System, 1950 - 1964, pp. 137-38, for other production contractors, etc.

directly with their counterparts at the Redstone Arsenal. As a result, embarrassing, out-of-control situations developed, and the atmosphere at the lower echelon was charged with confusion and frustration.

(U) A typical instance of OCO staff interference in matters supposedly reserved to the Redstone Arsenal occurred in January 1952, when the Resident Ordnance Officer at the Douglas Aircraft Company reported "some examples of how ORDTU is actually exercising technical supervision and how at least one aspect of the project appears to be suffering from a lack of coordination." Citing this information in a memorandum to the Chief, Technical and Engineering Division, Colonel Durrenberger, then Director of Projects, noted that representatives in the Los Angeles area had complained about such interference on several previous occasions. In view of the adverse impact on the program schedule,[43] he suggested that a letter be written "recommending that research and development responsibility on the Honest John project be returned to OCO." The alternative, he said, would be a letter "requesting that actual responsibility for conducting this . . . work be transferred to the arsenal," adding that the "present situation appears to be untenable."[44]

(U) Flatly rejecting the proposed action, Col. Severin R. Beyma, then head of the Technical and Engineering Division, took the position that the Arsenal's "technical responsibility should not be questioned." Most of the "apparent interference," he argued, "has been due to acceleration of the program and direct orders from higher authority than ORDTU . . . ." He went on to say that the reports of the Resident Ordnance Officer, while "quite clear" and adequate, "may easily be

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[43] For an account of the technical and administrative problems and the resultant schedule slippages during the 1951-52 period, see Cagle, History of the Basic (M31) Honest John Rocket System, 1950 - 1964, pp. 66-75.

[44] Memo, Dir of Projs, RSA, to Chf, T&E Div, 14 Jan 52, sub: Resp for HJ Dev Proj. HJ R&D Case Files, Box 14-9, RHA AMSC.

misinterpreted by people who have not been as closely connected with this program as the Rocket Development Group has been."[45] The failure of the Arsenal Commander to challenge this position reflects a weakness in the internal management structure which will be treated in more detail later in this chapter. For present purposes it will suffice to point out that Colonel Durrenberger, having been a member of the OCO staff before transferring to Redstone in July 1951, had an intimate knowledge of Ordnance Corps operating policies and practices.[46] Moreover, since it was his responsibility as Director of Projects to supervise activities of the Resident Ordnance Officers and to direct and coordinate project activities within the Arsenal,[47] the insinuation that he simply "misinterpreted" the report owing to a lack of familiarity with the program contravened both fact and logic.

(U) Another incident pointing up the complications of divided authority and responsibility concerned a procurement action, in February 1952, for 120 Honest John booster cases. In consonance with established procedure, the Rocket Development Group had solicited and received competitive bids from several qualified suppliers, and had recommended the Barium Steel Corporation for the award over the Burnham Corporation because of a price differential of some $64,500. The merits of this recommendation notwithstanding, the Chief of the Rocket Branch, R&D Division, OCO, directed that the booster cases be procured from the Burnham Corporation. The damaging influence of this arbitrary decision on Government-contractor relationships and the obvious feeling of abject frustration among Arsenal personnel are vividly portrayed in the following Memorandum for Record.

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[45] 1st Ind, Chf, T&E Div, to Dir of Projs, 17 Jan 52, on Memo, foregoing footnote. File same.

[46] __See__ above footnotes 10 and 11.

[47] RSA Admin Instr 300-15-51, 6 Aug 51.

During a conference on "Honest John" booster procurement attended by . . . Arsenal personnel and Col Lewis, OCO, the teletype directive . . . from OCO, specifying procurement of the . . . boosters thru Burnham Corporation, was discussed. . . . Mr. Womble [pointed out] that great pains had been taken in procuring quotations from . . . suppliers who controlled their own material supplies and had the engineering and fabricating competence to handle this production on a substantial scale. Compliance with the directive involved upsetting relations with these various suppliers who had gone to considerable pains and expense in conducting investigations and preparing quotations.

A telephone call was placed to Mr. Jones [ORDTU-OCO] to discuss the matter and present the above facts. After an extended argument . . ., Mr. Jones insisted that the directive be complied with. . . .[48]

(U) Because of the broad scope of authority retained by the OCO, Arsenal project personnel spent an enormous amount of time and money for temporary duty travel to the Pentagon. Sometimes they went there of their own volition to obtain urgently needed decisions, to solve conflecting directives or differences of opinion, or to present detailed justification for proposed plans, actions, or decisions. And very often they were invited there to answer for some program delay or other untoward development over which they had little or no control. That their reception by the Pentagon hierarchy was not always cordial is clearly evident in this candid observation by one of the project officers.

Col. Petrolino of ORDIM was also encountered during this visit, and had succeeded in feeding this officer half way through a nearby pencil sharpener before it could be established that this officer (a) was not connected with NPD and (b) was not connected with HONEST JOHN, although indeed from Redstone Arsenal. It developed that General Collins had been or was about to be called before a Congressional committee concerning some diddling with S. D. Hicks on HONEST JOHN procurement by this arsenal.

Indeed, it was noted during this visit that personnel at OCO appear to be serious in cursing Redstone, whereas previously it had

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[48](1) MFR, Edwin L. Rose, 28 Feb 52, sub: Proj TU2-1029 - HJ Booster Proc. HJ R&D Case Files, Box 14-9, RHA AMSC. (2) Also see Cagle, History of the Basic (M31) Honest John Rocket System, 1950 - 1964, p. 53.

appeared to be more in a joking mood.[49]

(U) In summary, the Ordnance Corps management structure was indeed a complex arrangement with obvious weaknesses that blocked effective operation at the field level. The tendency of OCO divisions to overstep the limits of their responsibility and become involved in field operating functions was reflected in virtually every phase and facet of Redstone's mission operations. That these weaknesses did in fact exist was borne out by the findings of the Army Comptroller's management survey completed in late May 1953. Among the changes recommended by the survey team were (1) the removal of the responsibility and authority for major operating functions from the OCO to middle management or command level; and (2) the limitation of activities at the OCO level to "topmost policy, program development, program execution, program review and analysis, coordination and control."[50] As a result of this survey and other similar studies conducted during and after 1953, the Chief of Ordnance carried out an extensive plan for full decentralization by delegating authority and responsibility for major operations to field commands.[51]

(U) As far as the Redstone Arsenal was concerned, the change began in early 1954, with the assignment of responsibility for technical supervision of some new R&D projects and for technical control of some of the older projects. The Honest John, of course, fell in the latter category, the R&D Division, OCO, relinquishing the technical control responsibilities on 8 February 1954, just a few weeks after the first

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[49] (1) Memo, Proj Off Jato XM5 to Proj Off Jato XM6, 24 Feb 53, sub: Discussions with OCO 20 Feb 53. HJ R&D Case Files, Box 14-8, RHA AMSC. (2) The reference to S. D. Hicks and the National Procurement Division (NPD) concerned the competitive bids solicited for the first volume procurement in FY 1953, which bids were cancelled in late February 1953 at the direction of the OCO. See Cagle, op. cit., pp. 57-58.

[50] Management Survey of the Ordnance Corps, 22 May 53, copy in OHF. (As cited in Snodgrass, Organization and Management of the Ordnance Corps, 1945 - 1958, p. 42.)

[51] Ibid., pp. 5, 74-75, 86-87.

production units reached the field.[52] Henceforth, the OCO devoted less time to routine engineering matters and placed greater emphasis on top-level program coordination, long-range planning, and more effective general management. During a series of conferences held at the White Sands Proving Ground early in March 1954,[53] Lt. Col. A. L. Stevens, representing the Rocket Branch, R&D Division, OCO, exhorted all agencies involved in development of the Honest John system to "coordinate their efforts harmoniously and with as little delay as possible in order that the entire program may proceed smoothly." He encouraged direct contact between and among these agencies on "relatively minor engineering matters" as long as overall policy, funding, etc., were not affected. For example, when one agency observed materiel deficiencies requiring action by another agency, the two agencies concerned could work out a solution by mutual coordination and advise the OCO of such action after, rather than before, the fact. Colonel Stevens emphasized, however, that his office should be contacted first in all matters relating to overall policy direction and control.[54]

(U) The delegation of additional authority and responsibility alleviated some of the managerial problems. However, the installation commander continued to experience internal coordination difficulties and did not gain absolute control of his assigned weapon system programs until the U. S. Army Ordnance Missile Command was established on 31 March 1958.[55]

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[52] Ltr, CofOrd to CG, RSA, 8 Feb 54, sub: RAD Order No. ORDTU 40401120-30-62129, Proj TU2-1029, DA Pri 1A (Amdt 1). ORDTU File, Jan - Feb 54, FRC.

[53] With representatives of the Redstone and Rock Island Arsenals, the White Sands Proving Ground, the Sandia Corporation, and the Douglas Aircraft Company.

[54] Ltr, CofOrd to CG, RSA, 15 Mar 54, sub: Conferences - 762mm Rkt (HJ) Msl Sys, 1-5 Mar 54. ORDTU File, Mar - May 54, FRC.

[55] *See* below, pp. 37-38.

(U) The Redstone Arsenal Project Management Structure

(U) To fulfill its diversified missions of research, development, production, supply, and maintenance for the Honest John and other Army missile systems, the Redstone Arsenal had to have the competence among its own people to control, coordinate, direct, and supervise all the work for which it was responsibile. With the bulk of the total effort being done by Government agencies and contractors at distant locations, this not only required a responsive management control system at the local level to coordinate the wide range of activities, but also a broad in-house scientific capability to direct and evaluate the contractors' efforts and assure quality results.

(U) By early 1953, the Arsenal had accumulated a complement of technical and professional personnel and had built up a sizable in-house research capability. But the development of a responsive management control system presented many difficulties which were not wholly solved until the spring of 1958. Some of the management problems, of course, stemmed from the existing division of authority and responsibility; others resulted from weaknesses in the internal management structure. There was no top-level mission control system and therefore no machinery for directing basic command policy or for assuring effective cross-coordination of important mission activities. As stated earlier, the separate and generally uncoordinated divisions of the OCO cut across established command lines and dealt directly with their counterparts at the Redstone Arsenal.[56] In like manner, each of the Arsenal's mission divisions operated as a decentralized functional enterprise, leaving the Arsenal Commander in the awkward position of having to accept the burden of responsibility without an opportunity to direct or control basic policy decisions.

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[56] *See* above, p. 15.

(U) Program Direction and Coordination

(U) Concurrently with the activation of the three national mission divisions on 6 August 1951,[57] Colonel Hudson realigned the expanded headquarters service elements along modified General Staff lines and strengthened his executive staff by the addition of a Director of Research & Development and a Director of Projects.[58] The creation of the latter office marked the beginning of a protracted and largely futile effort to resolve the perplexing interarsenal coordination problem.

(U) Lt. Col. William J. Durrenberger, who had been transferred to the Arsenal from the OCO in July 1951, took over as the Director of Projects on 6 August.[59] As a key member of the Arsenal Commander's staff, his duties were to keep the Commander advised on the status of all technical mission programs; to prepare policy directives governing the execution of technical missions; to direct and coordinate all guided missile and rocket projects involving two or more divisions; to maintain continual review of all projects being planned or conducted within the individual divisions to insure timely planning and participation by the other divisions; and to supervise the activities of Resident Ordnance Officers stationed at contractors' plants as representatives of the Arsenal.[60]

(U) The Ordnance personnel stationed at the various contractors' plants had been relieved from assignment to the Office, Chief of Ordnance, and placed under jurisdiction of the Redstone Arsenal on 1 July 1951. Among these was Maj. Harry E. Whitmore, then stationed at the Douglas Aircraft Company, Santa Monica, California (Honest John

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[57] See above, p. 7.

[58] RSA GO 5, 3 Aug 51.

[59] RSA SO 151, 2 Aug 51.

[60] (1) RSA Admin Instr 300-15-51, 6 Aug 51. (2) Also see RSA Semiannual Hist Sum, 1 Jul - 31 Dec 51, Sec 7. RHA AMSC.

and Nike Ajax contractor).[61] The staff of the Resident Ordnance Officers located in the Los Angeles area was immediately expanded with the assignment of additional engineering, quality control, and field service specialists on extended temporary duty.[62]

(U) On 16 August 1951, some 10 days after activation of the Office, Director of Projects, the OCO R&D Division transferred the R&D responsibility for the Corporal and Nike Ajax projects to the Redstone Arsenal, along with two experienced project officers. Because of the critical shortage of qualified technical personnel, Colonel Hudson decided to concentrate these and other available guided missile specialists in the Office, Director of Projects, where maximum use could be made of their experience in assisting all divisions of the Arsenal rather than a single division. At the end of December 1951, Colonel Durrenberger had a complement of four clerical and seven technical personnel, the latter serving as project coordinators for eight different systems—Honest John, Nike Ajax, Corporal, Lacrosse, Loki, Major, Hermes, and Terrier. The Honest John project coordinator was Cpl. W. G. Henke.[63]

(U) With the gradual build-up of contractor activity in the vicinity of Los Angeles, in late 1951 and early 1952, Arsenal officials began laying plans for a central liaison office to exercise technical supervision of R&D, production, and engineering services contracts. In the absence of a central command or control point in the area, the Resident Ordnance Officers were reporting individually to the Director of Projects at the

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[61](1) Ibid. Others included in the transfer were Maj. G. E. Parsons, Jr., stationed at the Jet Propulsion Laboratory, Pasadena, California; and Lt. Col. R. E. LeRoy, stationed at the Bell Telephone Laboratories, Whippany, New Jersey. (2) Lt. Col. Cecil P. Rice succeeded Major Parsons as Resident Ordnance Officer at the Jet Propulsion Laboratory on 1 July 1952. RSA SO 209, 1952.

[62]Memo, L. K. Liljegren, ROO-LAA, to Dir, OML, 12 Feb 53, sub: Rept on Estb of Ofc of RSA ROO-LAA, attached to Memo, Act Dir, OML, to Chf, T&E Div, OML, et al., 18 Feb 53, sub: Mtg with ROO-LAA, 20 Feb 53.

[63]RSA Semiannual Hist Sum, 1 Jul - 31 Dec 51, Sec 7. RHA AMSC.

Redstone Arsenal. To improve the reporting procedure and to insure effective coordination of project activities in the area, the Redstone Arsenal, in conjunction with the Los Angeles Ordnance District (LAOD), set up the Redstone Ordnance Office, Los Angeles Area (ROO-LAA), in August 1952. This headquarters office was originally headed by Lt. Col. Cecil P. Rice, who had complete command and control of all Arsenal personnel stationed in the Los Angeles area. It was located in the LAOD headquarters at Pasadena, with branch offices at Douglas Aircraft and other area contractors. Personnel to staff the headquarters office were furnished by the Redstone Arsenal through temporary duty assignments, transfers, and local hires.[64]

(U) By the early fall of 1952, the Director of Projects had made significant progress toward solving the interarsenal coordination problem, and, from all outward appearances, the new ROO-LAA was functioning smoothly and efficiently. This sense of progress was soon shattered, however. From the outset, Colonel Durrenberger had encountered stiff opposition from the division chiefs who resented staff control of their activities; and the effectiveness of his operation was ultimately diluted by wavering command support.[65] On 29 October 1952, after barely 15 months of operation, the Office, Director of Projects was abolished. Its functions were transferred to the newly created Arsenal Program Coordination Office of the Ordnance Missile Laboratories, where a skeleton staff of one company grade officer, two civilian engineers, and two clerks undertook the impossible task of coordinating

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[64](1) Ltr, CG, RSA, to Dist Chf, LAOD, 16 Aug 52, sub: Redstone Ord Ofc in the LAOD. (2) "Staff Study on Mutual Problem Areas of Los Angeles Ordnance District and Redstone Ordnance Office, Los Angeles Area," (LAOD, 15 October 1954), p. 1. (3) Memo, L. K. Liljegren, ROO-LAA, to Dir, OML, 12 Feb 53, sub: Rept on Estb of Ofc of RSA ROO-LAA, attached to Memo, Act Dir, OML, to Chf, T&E Div, *et al*., 18 Feb 53, sub: Mtg with ROO-LAA, 20 Feb 53.

[65]*See*, for example, the case cited above, pp. 18-19.

arsenal-wide mission activities.[66]

(U) Within 6 short weeks, the national mission programs had disintegrated into unilateral, functional-type operations over which the Arsenal Commander claimed little or no control. Colonel Durrenberger, who had been relegated to the post of Assistant Director, Ordnance Missile Laboratories, focused attention, in mid-December 1952, on the deteriorating situation and the need for immediate corrective action. He charged that there were some key administrators in both the OCO and the Arsenal mission divisions who paid only "lip service" to the importance of program coordination, and warned that the resulting impact on telescoped missile programs could be disastrous. Referring to problems in major missile programs in general, and to the collapse of interarsenal coordination in particular, he declared:

> Changes in the OCO coordination picture (retirement of General Quinton and assignment of the additional duty of guided missile coordination to Chief, R&D Division), plus the fact that we have now reached the 'eleventh hour' in the program (equipment about ready to be issued to troops), have made it imperative that our coordination operations at this arsenal be improved considerably. Failure to secure proper coordination at this arsenal is actually threatening the success of the Army's entire guided missile program. It seems unnecessary to point out what effect this may have on the country's defense.[67]

(U) This scathing indictment of the Arsenal's management structure, together with the equally critical findings of a subsequent staff study, brought prompt results. On 5 February 1953, the Arsenal Program Coordination Office was removed from the Ordnance Missile Laboratories, established as a special staff agency, and redesignated as the Mission Planning and Coordination Office.[68] The new office, however, was not

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[66](1) RSA Semiannual Hist Sum, 1 Jan - 30 Jun 53, p. 52. (2) Also see, Ibid., 1 Jul - 31 Dec 52, p. 174. Both in RHA AMSC.

[67]Memo, Asst Dir, OML, to Brig Gen H. N. Toftoy, Dir, OML, 12 Dec 52, sub: Coord of the GM and Rkt Programs.

[68](1) RSA GO 1, 5 Feb 53. (2) RSA Semiannual Hist Sum, 1 Jan - 30 Jun 53, pp. 52, 54. RHA AMSC.

delegated adequate authority and responsibility for effective top-level control and coordination of the mission programs. For example, the ROO-LAA and similar offices located in New York and New Jersey were left under the staff supervision of the Ordnance Missile Laboratories, with technical direction being exercised by all four mission elements.[69] Colonel Durrenberger underscored the basic weaknesses in the new organization when he wrote: "If and when a decision is made to establish a strong arsenal mission coordinating or directing office, then it appears that the . . . Resident Ordnance Officers might well be put under that office." Meanwhile, he said, their assignment to the Ordnance Missile Laboratories was preferable.[70]

(U) Throughout the ensuing 5 years, Arsenal management engineers made several attempts to pull the mission structure together, but their efforts proved useless. Invariably faced with accepting watered-down versions of the desired control system, they had to apply superficial remedies unbefitting the severity of the problem. The limitations thus imposed on the so-called "coordination offices"[71] set up during this period were both frustrating and far-reaching. The Arsenal's mission divisions continued to operate as decentralized, functional enterprises—or, as Maj. Gen. John B. Medaris said, "three separate empires"[72]—while

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[69] That is, by the Ordnance Missile Laboratories on R&D matters; by the National Procurement Division on production matters; by the Field Service Division on field maintenance matters; and by the Provisional Redstone Ordnance School on training matters.

[70] Memo, Asst Dir, OML, to Dir, OML, et al., 18 Feb 53, sub: Mtg with ROO-LAA, 20 Feb 53.

[71] These offices and their organizational location were as follows:

Mission Planning & Coordination Ofc..	(Special Staff	Feb 53 - Jan 54
	(Service Staff	Jan 54 - Oct 55
National Mission Coordination Ofc....	Executive Staff	Oct 55 - Feb 56
Plans Coordination Office............	(Executive Staff	Feb 56 - Jul 56
	(Service Staff	Jul 56 - Mar 58

RSA GO's 1, Feb 53; 5, Jan 54; 132, Nov 55; 22, Feb 56; and 57, Jul 56.

[72] Minutes of Staff Meeting No. 1, AOMC Hq, 1 Apr 58, p. 4.

the headquarters staff office did what it could to plan and coordinate the mission programs "after the fact" and within the bounds of its limited authority.

(U) Communication's Breakdown in the Los Angeles Area

(U) The success of Redstone Arsenal's expanding mission programs in the Los Angeles area depended in large measure upon a satisfactory basis of cooperation and liaison between Arsenal representatives and officials of the LAOD.[73] It will be recalled that the Arsenal assumed control of the Resident Ordnance Officers in early July 1951, and later established the Redstone Ordnance Office, in August 1952, to serve as a central control and coordination point.[74] By late February 1953, this office had accumulated a staff of 15 civilians and 3 military personnel, all of whom were housed in, and supported by, the LAOD headquarters at Pasadena.

(U) In setting up the formal functional statement for the ROO-LAA, on 20 February 1953, Arsenal officials took special pains to assure that relations with the LAOD were clearly delineated and fully understood by all personnel. At that time, some minor problems had arisen in connection with the required LAOD support; but these were reportedly solved "on the local scene" without difficulty and with no outward sign of friction or resentment.[75] During the ensuing 24 months, however, personnel of the ROO-LAA and the LAOD became embroiled in a bitter functional dispute that eventually led to a complete breakdown in

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[73]The LAOD, as well as other Ordnance Districts, operated under the supervision of, and reported directly to, the OCO, with responsibility for the negotiation, execution, and administration of contracts in accordance with Ordnance Procurement Instructions 1-205.7, 1 September 1952, sub: R&D Procurement. See Ord Corps Order 43-52, 29 Sep 52.

[74]See above, pp. 24-26.

[75](1) Memo, L. K. Liljegren, ROO-LAA, to Dir, OML, 12 Feb 53, sub: Rept on Estb of Ofc of RSA ROO-LAA. (2) Memo, Asst Dir, OML, to Dir, OML, et al., 18 Feb 53, sub: Mtg with ROO-LAA, 20 Feb 53.

communications and the consequent loss of authoritative control over high-priority contractor activities in the area.

(U) Because of the interrelated functions and responsibilities, some internal clashes were inevitable and, in the light of human nature, were perhaps even understandable. In most instances, the disputes apparently stemmed from misinterpretation of written duties and responsibilities, and the lack of a common meeting ground to settle individual differences. The problems of the ROO-LAA were further compounded by the loosely controlled channels of communication with the Redstone Arsenal, the responsibility for technical direction being splintered among all of the Arsenal's mission elements.[76] As for the LAOD, a smoldering resentment of the Redstone office gradually came to the surface and flamed into a full-blown controversy in the fall of 1954. Here, the bone of contention was the original assignment of a large personnel staff and the trend toward continued expansion: "The District was not receptive to this introduction of more Arsenal personnel into the LAOD area. It felt that there was no precedent or real need for such an increased staff as was proposed and established."[77] (During the period 20 February 1953 to mid-October 1954, the authorized personnel strength doubled: 18 to 36.)

(U) In October 1954, the District Chief, LAOD, made a staff study of "mutual problem areas" for the expressed purpose of reviewing and clarifying the overlapping functions and responsibilities, and recommending changes to eliminate duplication of effort and improve operating efficiency. The study cited numerous "cases" of unpleasant clashes, most of them ostensibly provoked by personnel of the ROO-LAA and culminating in "hard feelings between individuals," or "ill will between

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[76] <u>See</u> above, pp. 27-28.

[77] "Staff Study on Mutual Problem Areas of Los Angeles Ordnance District and Redstone Ordnance Office, Los Angeles Area" (LAOD, 15 October 1954), p. 1.

the contractor and contracting agency," or general "confusion and embarrassment." Criticizing Redstone personnel for unauthorized and uncoordinated discussions with contractors, the study group pointed to several instances where the contractor had discussed the same problem independently with both the LAOD and the ROO, and then played one against the other to his own advantage.[78] With respect to the performance of overlapping quality control functions, the study revealed that "Cooperation between LAOD and ROO/LAA personnel has diminished to the point where corrective action is almost mandatory."[79] The LAOD staff study brought more charges and counter-charges from personnel of the ROO. Both sides, however, were fully aware of the seriousness of the situation, and both were anxious to arrive at an acceptable solution to the problem.

(U) Meanwhile, the DCSLOG took the Chief of Ordnance to task for the lack of authoritative control and coordination of major missile programs in the Los Angeles area. At the behest of Maj. Gen. E. L. Cummings, then the Chief of Ordnance, the Commanding General of the Redstone Arsenal convened a conference of all interested parties on 4 January 1955 to consider recommendations for resolving the dispute.

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[78]In one case, an ROO engineer allegedly issued instructions, without the contracting officer's concurrence, on the painting of a missile motor. The contractor later filed for reimbursement, but the LAOD disallowed the expense because the work was not authorized in the contract. The problem "was finally resolved many months later, but after much effort . . . and with some hard feelings between individuals." Ibid., p. 3.

[79]Ibid., p. 4. One example: Redstone personnel allegedly followed the "extremely undesirable practice" of criticizing the contractors' inspection procedures and releasing such criticism to the contractors without LAOD concurrence. In another case, the ROO set up a meeting with Douglas Aircraft to discuss the quality control program, and invited LAOD personnel to attend. The ROO representative opened the meeting and immediately turned the discussion over to the Chief Inspector of the LAOD. "To his embarrassment," he had to "admit that LAOD personnel were there as interested observers and had not been previously informed they were to make the presentation." Ibid., pp. 3-4.

After a lengthy debate of the proposed solutions, he decided that the interest of the Ordnance Corps would best be served by the abolition of the ROO-LAA and the establishment of firm ground rules governing the activities of Arsenal technical representatives remaining in the area.[80]

(U) Realignment of the Field Liaison Structure

(U) Accordingly, the Redstone Ordnance Office, Los Angeles Area (including its branch offices at contractors' plants) was abolished effective 1 March 1955, and the Redstone Resident Ordnance Engineer (RROE) concept of operation was established. Most of the responsibilities and functions formerly assigned to the ROO-LAA were transferred to the LAOD, along with a proportionate share of the personnel and personnel spaces. The few R&D and industrial representatives required to accomplish the reduced Arsenal missions were attached to the LAOD for administrative purposes but remained under the operational and technical control of their parent divisions at the Redstone Arsenal. The balance of the civilian personnel were returned to the Redstone Arsenal.[81]

(U) Lt. Col. Cecil P. Rice (formerly chief of the ROO-LAA) became the Redstone Arsenal Liaison Officer with duty station at the LAOD, and continued to occupy that post until July 1955, when he departed for overseas duty.[82] He was succeeded by Lt. Col. Wells H. Gibbs who had been a member of the liaison staff since late 1954. In August 1955, Colonel Gibbs' duty station, as the Redstone Liaison Officer, was moved from the LAOD headquarters to the Jet Propulsion Laboratory, leaving

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[80] (1) Ltr, General Cummings to Brig Gen H. N. Toftoy, CG, RSA, 10 Dec 54. (2) Ltr, General Toftoy to General Cummings, 10 Jan 55.

[81] (1) Ibid. (2) RSA GO 31, 3 Mar 55.

[82] (1) RSA Officers' Roster, 31 Mar 55. (2) DA SO 89, 5 May 55.

only the civilian Ordnance engineers in District headquarters.[83]

(U) Under the new operational concept, the RROE's remaining in the Los Angeles area were physically located in the LAOD headquarters and adjacent to District personnel. They were no longer permitted to maintain separate resident offices in the contractors' plants. When their presence in the plants was absolutely necessary to obtain prompt action on engineering change orders, etc., they were integrated with other Ordnance Corps (LAOD) personnel in a single office labeled "Army Ordnance."[84]

(U) <u>Supervision of the Honest John Contractor</u>

(U) With numerous engineering change orders in process on the Basic Honest John and with the Honest John Improvement Program just getting under way,[85] the RROE concept of operation was far from adequate to meet the need for close technical supervision. Mr. W. F. McCann, who had succeeded Major Whitmore as R&D representative at the Douglas Aircraft plant,[86] had been monitoring both the Honest John and Dart projects since February 1954. In performing this dual supervisory function, he had

[83](1) RSA Officers' Roster, 31 Dec 54, 31 Jul 55, & 31 Aug 55; <u>Also see</u> RSA Officer Duty Card File. (2) Lt. Col. Kenneth O. Reed succeeded Colonel Gibbs as Redstone Liaison Officer at the Jet Propulsion Laboratory in September 1957 (RSA Officers' Roster, 30 Sep 57). He was transferred from Redstone Arsenal to the newly activated ARGMA on 1 April 1958, and became the Liaison Officer, R&D Division, on 1 July 1958 (RSA SO 70, Apr 58; ARGMA SO 71, Jul 58).

[84]Ltr, General Toftoy to General Cummings, 10 Jan 55.

[85]Preliminary Phase I studies had begun in December 1954, but the proposed development plan was not approved by the DA Staff until February 1955. The final detailed plan for use in negotiation of the R&D contract was approved by the Chief of Ordnance in April 1955. Ltr, CofOrd to CG, RSA, 8 Apr 55, sub: HJ Imprv Prog - RSA Rept No. 3M51P dated 11 Mar 55. ORDTU File, Jan - Jun 55, FRC.

[86]Exact time unknown—probably in late 1953 or early 1954.

maintained a desk at both contractors' plants (the Aerophysics Development Corporation and Douglas Aircraft) and divided his time between the two. Mr. McCann was exceptionally well qualified in the R&D field and had done an excellent job for both projects despite an extremely heavy workload and a lack of adequate clerical help. As a result of the organizational change in early 1955, and the subsequent withdrawal of R&D representatives from contractors' plants, the Arsenal not only lost the services of Mr. McCann but of other valuable R&D people as well.[87]

(U) In mid-February 1955, the Arsenal Commander appointed Mr. McCann as the RROE for the Honest John project, with the additional duty of monitoring the Dart program. As a member of the Redstone Arsenal, and specifically as a member of the Industrial Division, his duties were to serve as the senior Arsenal representative for the Honest John project in the Los Angeles area; to provide engineering assistance and advice as required to expedite the delivery of properly documented materiel to the user; to serve as technical consultant to the Resident Ordnance Inspector and other LAOD personnel on engineering and inspection problems; and to keep the Arsenal informed on the status of the project through periodic progress reports.[88]

(U) For a short while, Mr. McCann continued to monitor both projects much the same as before, except that he was not allowed to maintain an office in the contractors' plants—both of them located in Santa Monica, some 20 miles from LAOD headquarters. And, if he had not resigned his position shortly after the reorganization, the RROE concept might have worked out in spite of its disadvantages. As noted before, Mr. McCann was well versed in missile technology and therefore favored R&D functions over industrial. Mr. W. C. Wall, Jr., who succeeded McCann in the fall of 1955, was primarily interested in the industrial

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[87] Mary T. Cagle, Development & Production of the Dart Antitank Guided Missile System, 1952 - 1959 (ARGMA, 18 Jan 1960), pp. 30-31.

[88] Ltr, CG, RSA, to W. F. McCann, 14 Feb 55, sub: Estb of RROE - HJ.

field and was thus inclined to give more attention to that phase than to the R&D element.

(U) Hence, the Honest John project managers in the Redstone R&D Division could no longer rely on RROE reports as an effective management tool. Nor could they depend upon an industrial representative to maintain adequate technical supervision of the R&D contractor. Their control over the program received another setback in May 1957, when the Industrial Division withdrew the RROE (Mr. Wall) from the Los Angeles area and relocated him in the Dart production contractor's plant in Utica, Michigan. The only remaining source of contractor supervision was the Redstone Arsenal Liaison Officer stationed at the Jet Propulsion Laboratory. Here again, supervision of the Honest John contractor was performed on a "time-permitting" basis, first priority being given to other Ordnance Corps projects under way at the Laboratory. At best, the Liaison Officer could only make cursory management checks of the contractor's activity and report his findings to the Arsenal R&D Division.[89]

(U) Yet another problem resulting from the reorganization of early 1955 concerned the tight LAOD controls over contractor activities and the staunch refusal of the District Chief to permit direct communication between the Douglas Aircraft Company and the Redstone Arsenal. After enduring some 24 months of repeated delays in receipt of the Company's correspondence, the Arsenal Commander moved to have the communication restriction relaxed. While recognizing that communications involving contractual matters must, of necessity, be forwarded through the District, he argued that Douglas Aircraft correspondence on technical matters should be sent directly to Redstone, with a copy to the District office.[90]

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[89] Cagle, Development & Production of the Dart Antitank Guided Missile System, 1952 - 1959, pp. 33-35.

[90] Ltr, CG, RSA, to Dist Chf, LAOD, 5 Feb 57, sub: DAC Contracts ORD 693 and 673. HJ R&D Case Files, Box 15-95, RHA AMSC.

(U) In his reply—21 days later—the District Chief observed that his office had long recognized the desirability of providing easy access between contractors and the mission arsenal technical personnel on developmental programs, and conceded that "a great deal of direct oral discussion between technical people is necessary . . . in this type program." Nevertheless, he flatly refused to authorize direct written communication on the premise that it "inevitably leads to misunderstandings as to the Government's desires and the contractor's obligations."[91] The Arsenal Commander promptly replied that the existing communications channels were patently unsatisfactory, and asked the District Chief to reconsider. He emphasized that technical data and decisions obtained from the contractor were frequently needed for the release of priority work to other agencies, and that the flow of information through existing channels caused "delays that cannot be tolerated on an accelerated program such as Honest John."[92]

(U) This strong appeal notwithstanding, the LAOD stubbornly resisted any major change in the communication channel. With the OCO imposing essentially the same restrictions on direct communication with supporting commands and user agencies,[93] the Arsenal Commander found himself laboring in a bureaucratic maze that threatened to—and in some cases, did—undermine his authority and prestige as weapon system manager. In the fall of 1957, for example, the Chief of Ordnance rebuked the Arsenal Commander for sending routine comments on the XM-33 launcher directly to the Continental Army Command (CONARC) rather than through his office for a coordinated position. In a cutting reprimand, he told the Arsenal Commander that the CONARC had been advised that "comments

[91]1st Ind, LAOD to CG, RSA, 26 Feb 57, on Ltr cited above.

[92]2d Ind, CG, RSA, to Dist Chf, LAOD, 8 Mar 57, on above Ltr/Ind.

[93]Here, the Arsenal's problem was basically one of interpretation; that is, discerning the thin line between those matters reserved to the OCO and those falling within purview of "technical direction and control." See above, pp. 12-13, 21-22.

furnished by . . . [Redstone Arsenal] do not represent the Ordnance Corps position."[94] Obviously convinced that he had not over-stepped his delegated authority, the Arsenal Commander firmly stood his ground. He wrote:

> . . . [It] is essential that this arsenal deal directly with supporting commands and user agencies on technical problems that arise during the course of development. This arsenal therefore proposes to continue to deal directly with CONARC on such matters. All questions dealing with Ordnance Corps policy will be handled through your office. . . .[95]

(U) The New Look

(U) The action necessary to correct the long-standing deficiencies in Redstone's management structure came in late March 1958—right at the time the Honest John Improvement Program was in serious funding trouble and some 6 months before the final decision was made to carry it to completion.[96] On 31 March, the Secretary of the Army created the Army Ordnance Missile Command at Redstone Arsenal, Alabama, and appointed as its head Maj. Gen. John B. Medaris, who had earned a notable reputation for his dynamic administrative ability as Commander of the ABMA. Placed under General Medaris' direct control were the ABMA, the Jet Propulsion Laboratory, the White Sands Missile Range (formerly White Sands Proving Ground), the Redstone Arsenal, and the ARGMA. Officially established on 1 April 1958, the ARGMA assumed responsibility for the technical missions formerly assigned to the Redstone Arsenal, leaving the latter with post support and housekeeping functions.[97]

(U) The integration of primary research, development, test, and

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[94] Ltr, 00/7C-13764, to CG, RSA, 10 Sep 57, sub: Prelim Evaluation of HJ XM33 Lchr. HJ R&D Case Files, Box 15-95, RHA AMSC.

[95] 1st Ind, CG, RSA, to CofOrd, 3 Oct 57, on Ltr cited above.

[96] For further details on the uncertain status of the program in 1958, see below, pp. 77-78.

[97] (1) DA GO 12, 28 Mar 58. (2) Ord Corps Order 16-58, 31 Mar 58. (3) AOMC GO 6, 1 Apr 58.

logistical support installations under single direction, together with the administrative streamlining, would provide the means to carry out more effectively the existing and future priority missile programs. The unity of command that Redstone Arsenal had never been able to achieve thus became a reality under the AOMC structure. Among the first official actions taken by Brig. Gen. John G. Shinkle, the ARGMA Commander, was the establishment of a strong centralized management control system to be administered by the Agency Control Office. A significant part of the responsibility and authority delegated to this staff element was concerned with the activities of liaison personnel stationed at contractors' plants and Government installations.

(U) Effective with the policy directive issued in late June 1958, all Agency liaison personnel were appointed by the Agency Commander and assigned to the Chief, Control Office. Personnel located at the respective plants and installations were placed under direct command of a Senior ARGMA Representative (SXR) who operated under, and reported to, the Chief, Control Office. In carrying out his assigned functions, the SXR was to serve as senior spokesman and contact between the ARGMA and the contractor. Matters relating to the "formulation of new policy or resolution of policy conflict" were to be handled through the Control Office for a coordinated Agency decision. Other matters could be resolved directly with the Agency mission division involved, but with a single representative in charge of the overall mission at the contractor's level, effective control and coordination of significant program actions was assured.[98]

(U) As was expected, the subsequent implementation of this policy directive in the Los Angeles area brought a strong protest from the Chief of the LAOD. Recalling the "bitter past experience" arising out

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[98] ARGMA Cir 7 (later renumbered 600-1), 28 Jun 58. For full text of this directive and details on other aspects of the new control system, see ARGMA Hist Sum, 1 Apr - 30 Jun 58, pp. 32-46, 142-43.

of dual representation and authority, he suggested that "a review of the history of the Redstone Ordnance Office, Los Angeles Area, might result in avoiding similar problems." He pointed out that the "ground rules" effected in early 1955 had proved both "sound and workable," adding that "consideration should be given to maintaining the status quo as to the basic agreements . . . ."[99] This time, however, the AOMC policy prevailed.

(U) The aforementioned liaison policy was partially implemented with the designation and transfer of the SXR's on 3 August 1958. Messrs. L. V. Bilotta and A. R. R. Andrews were designated as SXR's at Douglas Aircraft plants in Santa Monica and Charlotte, North Carolina, respectively, and both were transferred from the Industrial Division to the Control Office.[100] Their assigned personnel and personnel spaces were transferred to the Control Office in mid-October 1958.[101]

(U) The Agency's field liaison personnel remained under the Control Office less than 2 years. In September 1960, operational control of the field offices was again relegated to mission division level. Under the revised policy, operational control of SXR offices was vested in the mission division having primary responsibility for the weapon system involved. All liaison personnel were still appointed by the Agency Commander and they were still assigned to the respective contractor plants under supervision of a single SXR, as before. But the formulation of new policy or resolution of policy conflict was no longer handled or coordinated at agency staff level. All policy matters were channeled to the appropriate mission division chief for staffing and

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[99] Ltr, Dist Chf, LAOD, to ARGMA Comdr, 8 Aug 58, sub: ARGMA Liaison Pers at Contractors' Plants and Govt Instls.

[100] DF, Dep Chf, ARGMA Control Ofc, to Chf, Civ Pers Ofc, 30 Jul 58, sub: Trf of SXR's.

[101] (1) DF, Chf, Projs Ofc, ARGMA Control Ofc, to SXR, DAC, 17 Oct 58, sub: Trf of Pers. (2) DF, Chf, Projs Ofc, to SXR, DAC COMP, Charlotte, N. C., 17 Oct 58, sub: same.

coordination; other routine matters were resolved through direct contact with subordinate elements of mission operations concerned. The new policy was implemented on 19 September, when the functions and personnel of all field offices were transferred from the Control Office to the appropriate mission divisions—in the case of the Douglas Aircraft Company field offices, to the Industrial Division.[102]

(U) The centralized control thus lost under the revised policy was supplanted, in part, by an internal commodity coordination procedure that had been established and implemented earlier in the year. This procedure was designed to provide the Agency Commander with the supplementary control and coordination necessary to assure integrated commodity managership. The system consisted of individual weapon system teams composed of one member from each of the mission operations and one Control Office member who served as team chairman. Members of the Honest John team were: Mr. W. P. Young, Chairman; Mr. R. H. Fink, R&D Operations; Maj. D. J. Walsh, Jr., Industrial Operations; and Mr. Paul Newman, Field Service Operations.[103]

(U) While the creation of the AOMC in the spring of 1958 had eliminated the managerial weaknesses in the internal organizational structure, major problems still existed in top-level program management. Most of these difficulties stemmed from the complex management structure under which the Ordnance Corps procurement programs were controlled and directed, and the interrelated and often conflicting missions and responsibilities of the major commodity commands and Ordnance Districts. In carrying out its weapon system management responsibilities, the AOMC was dependent upon the direct support of

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[102](1) DF, Chf, Control Ofc, to CG, AOMC, 12 Aug 60, sub: ARGMA Concept of Fld Rep Ofc Operations. (2) ARGMA GO 45, 25 Aug 60. (3) ARGMA Cir 600-1, revised 19 Sep 60.

[103](1) ARGMA Cir 1-2, 12 May 60, sub: Agency Commodity Coordination, & incl, List of Proj Offs by Wpn Sys Proj. (2) <u>Also see</u> ARGMA Semiannual Hist Sum, 1 Jan - 30 Jun 60, pp. 15-19.

both the commodity commands and the various Ordnance Districts.[104] As a result, the over-extended lines of communication made it virtually impossible to effect prompt and decisive action when a problem arose. Moreover, an inordinate number of personnel were involved in the decision-making process down through the command channels, causing much confusion and delay, as well as some functional disputes similar to those experienced in the Los Angeles area during the early 1950's.[105]

(U) An excellent example of how the system worked to the detriment of priority procurement programs occurred in the Honest John project in 1959. It involved major design and manufacturing deficiencies in the M405 rocket handling unit which was developed and produced under the cognizance of the Ordnance Weapons Command (OWC) and the Ordnance Tank-Automotive Command (OTAC), with the St. Louis Ordnance District (SLOD) as the contract administrator and the AOMC as the overall weapon system manager for the Chief of Ordnance. Beneath the major field commands was another layer of subordinate agencies having a part in the program—among them, the ARGMA and the Rock Island, Detroit,

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[104] Aside from the AOMC, the commodity commands were: Ordnance Ammunition Command (OAC), Joliet, Ill.; Ordnance Tank-Automotive Command (OTAC), Detroit, Mich.; Ordnance Training Command (OTC), Aberdeen, Md.; Ordnance Weapons Command (OWC), Rock Island, Ill.; and Ordnance Special Weapons Command (OSWAC), Dover, N. J. The responsibility for contract administration was divided among 14 Ordnance Districts with headquarters in Los Angeles, San Francisco, St. Louis, Chicago, Cleveland, Detroit, Cincinnati, Birmingham, Philadelphia, Pittsburgh, New York, Springfield, Boston, and Rochester.

[105] In the SLOD, for instance, Colonel Pardue complained that OTAC personnel were "trying to run" a contract on an Honest John item (M405 trailer) being furnished in support of the AOMC. Said he: "... [We] have too much of OTAC going ... to the contractor on matters which should be taken up with the district. We find ourselves continually in the position of having given information to OTAC and then find OTAC checking on us ... with the contractor.... [We] have found ourselves committed to impossible courses of action ... without having been a party to these things...." Memo of FONECON, Lt Col N. C. Pardue, SLOD, to Lt Col C. Prosser, OTAC, 9 Jun 59. (Note the similarity between this complaint and that registered by the LAOD nearly 5 years earlier. See above, pp. 30-31.)

Raritan, Rossford, and Picatinny Arsenals. At the other end of the spectrum were the using agencies—both in the Continental United States and overseas—which registered strong complaints of major deficiencies in the equipment.[106] And in the middle of the heap was the production contractor, Spencer-Safford Loadcraft, Inc., whose president bitterly scored the Government in two particularly derisive complaints:

> June 2, 1959: I am most displeased with the way we are NOT getting shipping authority on the . . . [25 reworked] trailers. . . . The government is placing on us an unreasonable, unwarranted, and unnecessary burden. . . . The confusion and extra cost caused by this failure to provide timely shipping data cannot be over-emphasized. PLEASE DO SOMETHING NOW.

> June 6, 1959: . . . [We now] have certain authority to ship [23 of the 25 units] but we lack 'port approval,' whatever that is. This [is] not only ridiculous - it is assanine (sic). Surely someone in the government can unscramble the red tape to allow shipment of trailers which I think someone in the govenrment (sic) wants and on which we need to finish loading out and in turn get our payment.[107]

(U) An investigation completed by ARGMA personnel in late August 1959 disclosed that the contractor's "marginal" production capability and his "belligerent and non-cooperative attitude" had contributed greatly to the existing problem, but that the Government had compounded the difficulty by allowing the program to become entangled in red tape and complicated management procedures. The findings of the study indicated, among other things, that the complex communication cycle had

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[106] In May 1959, the ARGMA learned that General White, USAREUR, had complained of 16 deficiencies to the OWC; that Fort Sill had reported 15 deficiencies—9 attributed to bad design and 6 to poor workmanship; that the East Coast shipping port was returning defective trailers to Raritan Arsenal for corrective action; and that the West Coast port had refused to accept the trailers without 90 days' supply of spare parts which were not yet available. MFR, R. D. Backer, 15 May 59, sub: Design & Mfg Deficiencies on the M405 Tlr [Relayed by phone, Col Kornet, OCO, to Maj D. J. Walsh, Jr., ARGMA Industrial Div].

[107] Ltrs, L. E. Weiss, Spencer-Safford Loadcraft, Inc., Augusta, Kansas, to SLOD.

blocked effective management of the program; that numerous visits made to the contractor's plant by Government representatives had caused confusion, resentment, and delay; and that far too many people were directly involved in decision making at the various levels.

(U) Item: On 3 August 1959, the Agency sent a teletype message to the OWC, requesting "urgently" needed information on the revised delivery schedule. The OWC bucked the message on to the OTAC which, in turn, relayed it to the SLOD for reply back through the same channels. The reply was still enroute 11 days later and "numerous telephone calls" were required to expedite it.

(U) Item: At the time of the investigation, 83 people from 7 Government agencies had made 177 visits to the contractor's plant, spending an astounding total of 701 days.

(U) Item: In a 2-day meeting held at the SLOD in July 1959, a total of 30 people from 4 agencies (ARGMA, OWC, OTAC, SLOD) participated in the discussion of a problem that could have been resolved by a much smaller group.[108]

(U) In addition to recommending solutions to the immediate problem, the study group outlined a course of action designed to prevent recurrence of such a situation in the future. Specifically, it recommended:

> That action be taken to resolve existing conflicts between current Ordnance Corps Orders [OCO's] assigning national mission responsibilities, and OCO 16-58, which assigns [AOMC's] systems management responsibility. The provisions of OCO 16-58 should be supplemented to clarify and delineate the scope and intent of systems management responsibility to all Ordnance commodity commands and arsenals and to the Ordnance districts.[109]

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[108] Rept, ARGMA Industrial Div, 24 Aug 59, sub: Investigation of Design and Manufacturing Deficiencies in the Handling Unit, 762mm Rocket, Trailer Mounted XM405E1, with 36 exhibits. (The items as here cited are paraphrased from pages 2-4 of report.)

[109] Ibid., p. 11.

(U) The Chief of Ordnance published an order clarifying the scope and intent of systems management responsibilities.[110] But the aforementioned program management deficiencies were not entirely eliminated until the Department of the Army reorganization of 1962. Effective 1 August 1962, the newly created U. S. Army Materiel Command (AMC) assumed the functions and responsibilities formerly assigned to the Office, Chief of Ordnance, and the Army Ordnance Missile Command became known as the U. S. Army Missile Command (MICOM), a Class II activity under jurisdiction of the AMC.[111] At that time, a new project and product (later commodity) manager system was set up under policies enunciated by the AMC. The Honest John system was placed in the commodity manager category where it remains today under the direction of Col. C. D. Sterner.[112]

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[110] Ord Corps Order 22-59, 10 Aug 59.

[111] (1) DAGO 46, 25 Jul 62. (2) As noted earlier, the ARGMA and ABMA were abolished in December 1961 and their functions absorbed by the AOMC headquarters. See above, p. 9.

[112] (1) Annual Hist Sum, MICOM, 1 Jul 62 - 30 Jun 63, pp. 5-9. (2) MICOM GO 88, 9 Nov 64.

CHAPTER II

(U) ORIGIN OF THE HONEST JOHN IMPROVEMENT PROGRAM (U)

(U) Basic research and engineering studies on ways and means of extending the effective range of the interim Honest John rocket actually began as a parallel effort in 1952. In order to provide an early operational capability, the aerodynamic design of the interim emergency weapon was necessarily frozen in the early stages of development before the full potential of the rocket design could be investigated. Using the engineering data and experience gained from developmental tests of the interim (M31) rocket, the Ordnance Corps initiated several study programs aimed at providing a family of large-caliber atomic rocket weapons with overlapping tactical range capabilities. The military characteristics finally approved for the Basic M31 Rocket specified a maximum effective range of 30,000 yards and a minimum range of 10,000 yards. While developing this middle-range rocket, the Douglas Aircraft Company conducted engineering studies of similar atomic delivery systems with shorter and longer tactical ranges of 5,000 and 60,000 yards, respectively. A number of different proposals were submitted for consideration during the 1952 - 54 period, but the field was finally narrowed down to an improved version of the M31, 762-mm. rocket, designated as the XM-50, and a smaller-caliber companion system, known as the Littlejohn.

(U) Engineering Design Studies (U)

(U) Among the early attempts to extend the tactical range capabilities of the 1236F (M31) rocket was an aerodynamic study of two similar Honest John models carrying the smaller, 22-inch, TX-12 atomic warhead. In this study, the Douglas Aircraft Company sought to establish theoretical performance estimates for Honest John Models 1236F,

1236I, and 1236J. The only difference between the standard 1236F rocket and the "I" and "J" models was that the latter were to have a maximum payload diameter equal to the existing 23-inch motor diameter and reduced payload weights of 1,000 and 1,200 pounds, respectively. The standard Honest John, of course, used the bulbous-type, 1,500-pound warhead measuring 30 inches in diameter. The results of the study, published in April 1952, indicated a maximum obtainable range of about 28,800 yards for the 1236F model; 37,100 yards for the 1236I (with a 1,000-pound payload); and 36,100 yards for the 1236J model (with a 1,200-pound payload). The minimum ranges estimated for the "I" and "J" models were 18,000 and 17,700 yards, respectively.[1]

(U) Having established that smaller diameter, lower weight warheads with relatively high yields could be developed, the Assistant Chief of Ordnance, in May 1953, outlined plans for a series of heavy bombardment rockets based on the Honest John and designed to deliver both atomic and conventional payloads to tactical ranges of 5,000 to 60,000 yards. At that time, theoretical studies had been completed on a short-range round, known as the Honest John Junior, to overlap the estimated 12,000-yard minimum range of the standard M31 rocket, and a long-range round, known as the Honest John Senior, which would have a maximum range of approximately twice that of the M31. The proposed Honest John Junior would carry a 1,200-pound payload to ranges of 5,000 to 15,000 yards, while the larger Honest John Senior would be capable of carrying 1,200- and 2,800-pound payloads to ranges of 24,000 to 60,000 yards. These rounds, if successfully developed, would supplement the middle-range

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[1]DF, CofOrd to ACofS, G-4, 14 Nov 52, sub: Utilization of HJ as a 22-Inch Warhead Carrier. ORDTU File, HJ Project TU2-1029, Nov - Dec 52, Military Records Branch, Federal Records Center, Region 3, General Services Administration, Alexandria, Va. (These retired Ordnance Corps files are hereafter cited as follows: ORDTU File, [period covered], FRC.)

standard Honest John which was then in the service test stage.[2] As an interim solution to the short-range problem, the Douglas Aircraft Company sought to reduce the effective minimum range of the M31 rocket to 5,000 yards by incorporating a system of drag brakes in a modified round known as the Demijohn. This effort, however, was eventually abandoned because of technical difficulties.[3]

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(~~S~~) Honest John Junior and the Littlejohn (U)

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(~~S~~) The Douglas Aircraft Company completed the engineering design study on the Honest John Junior in September 1953. Yet a formal requirement for the system—to be known as the Littlejohn—was not established by the Department of the Army until August 1954. The approved military characteristics called for a free-flight rocket system capable of carrying a small atomic warhead to a maximum range of at least 18,300 meters (about 20,000 yards), with a minimum range of 3,200 meters (about 3,500 yards). The initial Littlejohn specifications included a requirement that the rocket be capable of launch from both a self-propelled launcher[4] and a lightweight helicopter-transportable launcher. The lightweight system was to be air transportable in Phase I and Phase II airborne

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[2](1) MFR, H. G. Jones, Rkt Br, R&D Div, OCO, 15 May 53, sub: Atomic Rkt Wpns. ORDTU File, May - Jun 53, FRC. (2) Ltr, CofOrd to CG, APG, 16 Jul 53, sub: Comparative Study of Dlvry Methods for Atomic Wpns. ORDTU File, Jul - Sep 53, FRC.

[3]For details on the Demijohn, see Mary T. Cagle, History of the Basic (M31) Honest John Rocket System, 1950 - 1964 (MICOM, 7 April 1964), pp. 128-30.

[4]Under the development plan originally proposed for the Honest John Junior, the rocket was to be launched from the existing XM-289, self-propelled Honest John launcher without modification. The underlying philosophy of this approach was to afford the same Field Force battalions the flexibility of firing either the Honest John or Honest John Junior, depending on the tactical mission, without specialized equipment or training. MFR, Rkt Br, R&D Div, OCO, 22 Sep 53, sub: HJ Jr., Proj for. ORDTU File, Jul - Sep 53, FRC.

operations, the latter phase including cargo helicopters of the H-34 and H-21 class. The requirement for the self-propelled launcher was later dropped.[5]

(U) Development of the 318-mm. Littlejohn System began in February 1955 with a target date of 1 August 1957 for delivery of initial tactical units. Because of technical difficulties and delays during the first year of development, it became apparent that an acceptable helicopter-transportable system could not be made available within the desired time frame. To provide an interim system for the new 101st Airborne Division, the Chief of Research and Development, in February 1956, directed the Ordnance Corps to initiate development of a lightweight, helicopter-transportable launcher for the 762-mm. Honest John Rocket.[6] The end product of this highly accelerated effort was the M33 launcher system. It was designed with minimum weight to permit transport by helicopter and with sufficient ruggedness to withstand shock of airdrop required for Phase I operations.[7]

(U) At the same time, the Ordnance Corps developed a similar lightweight launcher, the XM-34, for use with the 318-mm. Littlejohn rocket. While the XM-33 and XM-34 launchers grew out of two separate weapon system projects, their marked similarity—both in inherent technical problems and military requirements—dictated that development be accomplished in a

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[5](1) Ibid. (2) Littlejohn Weapon System Master Plan, ABMA WSP-5, 10 Sep 61, pp. 3, 7, 8.

[6](1) Ibid., p. 3. (2) DF, CRD/C-2239, CRD, OCofS, DA, to CofOrd, 15 Feb 56, sub: Initiation of HJ Hel Transbl Lchr Prog. (3) Ltr, CRD/C-4620, Msls & Air Def Div, OCRD, OCofS, to CG, CONARC, 30 Mar 56, sub: Hel Transbl Lchr for HJ. Both in ORDTU File, Jan - Apr 56, FRC.

[7](1) HJ Missile System Plan, ARGMA MSP-11, 1 Jun 60, pp. 1-A, 3-D, 20-D. (2) See below, pp. 209ff.

parallel, closely coordinated program.[8] The Ordnance Corps also used this approach to good advantage in developing certain other components common to the Honest John and Littlejohn systems.

(U) Engineering Studies of a Long-Range Honest John Rocket (U)

(U) The task of designing an acceptable large-caliber rocket for the long-range member of the Honest John family proved exceedingly difficult and expensive. During the 1952 - 54 period, the Douglas Aircraft Company investigated a number of possible solutions to the problem, including both free-flight and semicontrolled models; however, a formal requirement for the long-range Honest John never materialized. The Ordnance Corps thus abandoned the program in late 1954 after a total expenditure of more than $125,000, and turned instead to the development of an improved version of the standard M31 Honest John system.

(U) Comparison Study of Guided and Unguided Rockets (U)

(U) The original objective of the program was to design a large-caliber rocket capable of delivering 1,200- and 2,800-pound payloads to ranges of 24,000 to 60,000 yards. Recognizing that the main problem would center around the achievement of the desired accuracy at long range, the Chief of Ordnance, in early 1952, had the Douglas Aircraft Company investigate the feasibility of adapting a guidance control system to the 1236F model Honest John rocket which was then being rushed through development for interim tactical use. This study actually involved a comparative analysis between the existing free-flight 1236F

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[8] (1) Ltr, CG, RSA, to CofOrd, 1 May 56, sub: HJ - LJ Hel Transbl Lchr Sys. (2) Ltr, CRD/C-6405, OCRD, OCofS, DA, to CG, CONARC, 2 Jun 56, sub: Hel Transbl Lchrs for HJ & LJ. (3) DF, 00/6C-16759, CofOrd to CRD, OCofS, 13 Aug 56, sub: Feas of Aerial Dlvry of the HJ & LJ Sys. All in ORDTU File, May - Aug 56, FRC.

model with a regulated spin program and the 1236G semicontrolled model[9] using a free gyro to correct for thrust malalignment and thus reduce dispersion error.

(U) The study report, published in July 1952, indicated that the installation of a control system on the 1236F rocket would not result in an improvement of accuracy that should even be considered at the existing medium range of 27,500 yards. It further showed that ranges beyond that established for the 1236F rocket could only be obtained with an assisted or two-stage type of Honest John, or by increasing the motor diameter and/or length.[10]

(U) Subsequent engineering design studies of long-range rockets therefore embraced several alternate versions of the Honest John, including the 1236FF and 1236FF-V, both two-stage models, and the single-stage Honest John Senior. None of these proposed systems was approved for development, but the engineering data and experience gained from the studies were later used to good advantage in designing and developing the Improved XM-50 Honest John Rocket.

(U) <u>Honest John Models 1236FF and 1236FF-V</u> (U)

(U) These long-range versions of the Honest John evolved from a preliminary aerodynamic study conducted early in 1952 to determine the

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[9]The Model 1236G rocket had been included (along with the 1236F) in the initial Honest John development plan of 1950-51, but it was dropped from active consideration in August 1951, when the program was placed on a crash basis. <u>See</u> Cagle, <u>History of the Basic (M31) Honest John Rocket System, 1950 - 1964</u> (MICOM, 7 April 1964), pp. 30, 34, 35, 37, 44, 49.

[10](1) DAC Rept No. GM-14410, 1 Jul 52, sub: Revised Estimates of Accuracy of HJ Models 1236F & 1236G. RSIC. (2) 1st Ind, 00-471.9/2997, CofOrd to OCAFF, 6 May 53, on Ltr, ATDEV-8 471.94, OCAFF to CofOrd, (date unk), sub: Guidance of Large Rkts During Burning. ORDTU File, May - Jun 53, FRC.

feasibility of a two-stage type of rocket for possible use as an overtest vehicle for atomic warhead components. The resulting research vehicle, designated as Model 1236FF, consisted essentially of one complete Honest John rocket with an additional motor assembly to act as a booster. In May 1952, shortly after completion of the initial study, the Atomic Energy Commission dropped this two-stage model in favor of another type of research vehicle known as the Father John. Based on the results of this preliminary work, the Chief of Ordnance decided, in the late fall of 1952, to initiate a more detailed aerodynamic study to determine the feasibility of using the two-stage design as a long-range delivery system.[11]

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(~~S~~) The Douglas Aircraft Company completed the follow-on engineering study of the 1236FF model in early January 1953. The proposed design was that of a two-stage missile having a gross weight of 10,075 pounds and capable of carrying a 30-inch, 1,500-pound payload to a maximum range of 60,000 yards. The main shortcoming in this design stemmed from the lack of desired accuracy. The expected differential spin torque loads between the main rocket and the booster section ruled out the use of spin rockets, leaving the launcher track as the only means of guidance.[12]

(U) To provide accuracy comparable to that obtained with a regulated spin program, the Chief of Ordnance reoriented the program to include a study of an alternate two-stage model, designated as the 1236FF-V. The first stage of this rocket was to be equipped with gyro-controlled, hydraulically-actuated jet vanes for initial stabilization; the second stage would be a free aerodynamic missile.[13] The Douglas Aircraft

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[11](1) Ibid. (2) For details on the Father John, see Cagle, History of the Basic (M31) Honest John Rocket System, 1950 - 1964, pp. 98 - 100.

[12]"ORDTU Report to Chf, R&D," [Results of Study on 1236FF Rkt], 5 Jan 53. ORDTU File, Jan - Feb 53, FRC.

[13]Ltr, CofOrd, to CG, RSA, 12 Jan 53, sub: HJ Model FF-V. HJ R&D Case Files, Box 14-8, RHA AMSC.

Company began the engineering design study in April 1953, under a $24,869 supplement to its Honest John R&D contract.[14] The FF-V study program continued on a priority basis until August 1953, at which time primary emphasis was shifted to the design of a more promising single-stage rocket, the Honest John Senior. Work on the two-stage model ended with the submission of the final study report and proposal-type drawings in late 1953.[15]

(U) Honest John Senior (U)

(U) The Douglas Aircraft Company began work on a design proposal for the Honest John Senior in May 1953. As a basis for the feasibility study, it used the preliminary design of a 6.5-KS-145,000 JATO unit,[16] the potential ballistic properties of which had been established in an earlier study by the Thiokol Corporation, Redstone Division. The general characteristics used as the criteria for the study called for a large-caliber, single-stage rocket capable of carrying a 30-inch, 1,500-pound conventional payload or a 45-inch, 3,000-pound atomic payload to a range of not less than 60,000 yards. The rocket could be designed to follow a free ballistic trajectory or it could incorporate jet vane control.[17]

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[14](1) Ltr, DAC to LAOD, 8 Apr 53, sub: Cost Est for HJ Model FF-V. (2) Ltr, Dist Chf, LAOD, to CG, RSA, 9 Apr 53, sub: HJ Model FF-V. Both in HJ R&D Case Files, Box 14-8, RHA AMSC.

[15](1) Ltr, DAC to CG, RSA, 20 Aug 53, sub: Transmittal of HJ Sr Design Study Proposal (DAC Rept No. SM-14886). HJ R&D Case Files, Box 14-8, RHA AMSC. (2) DF Cmt 2, 00 471.9/1610, CofOrd to ACofS, G-4, 13 Aug 53, sub: HJ Sr and HJ Jr. ORDTU File, Jul - Sep 53, FRC. (3) MFR, Rkt Br, R&D Div, OCO, 20 Nov 53, sub: HJ Sr Briefing. ORDTU File, Oct - Dec 53, FRC.

[16]The code designation of the proposed rocket motor denotes the burning time (6.5 seconds); the type propellant (K - Perchlorate with nonasphaltic fuel, S - Solid composition not readily deformed); and the nominal thrust (145,000 pounds).

[17](1) Ltr, Thiokol Corp., Redstone Div, to CG, RSA, 9 Mar 53. (2) Ltr, CofOrd to CG, RSA, 16 Apr 63, sub: Surface to Surface Large Cal Arty Rkt - HJ Sr. (3) Ltr, CG, RSA, to LAOD, 28 May 53, & incl thereto, "Tentative Military Characteristics, Honest John Senior." All in HJ R&D Case Files, Box 14-8, RHA AMSC.

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(~~C~~) In its initial proposal, submitted in August 1953, the Douglas Aircraft Company recommended that the Honest John Senior be designed as a spin-stabilized rocket with a 45-inch warhead, an overall length of about 446 inches, and a gross weight of approximately 11,700 pounds.[18] Not satisfied with the features of this preliminary design, the OCO directed that the contractor continue the study with primary emphasis on an optimum design as a carrier for the 1,200-pound XW-7 warhead. The rocket was to be capable of carrying a 30-inch, 1,500-pound conventional payload (fitting within the XW-7 warhead envelope) to a maximum range of 60,000 yards. The minimum range for both warheads was to overlap the 27,500-yard maximum range of the Basic Honest John. In addition, the contractor was to determine the feasibility of reducing the minimum range to 5,000 yards by the use of drag devices similar to those employed on the Demijohn.[19] The Douglas Aircraft Company conducted this engineering design study under a $97,291 supplement to the Honest John R&D contract.[20]

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(~~C~~) The extended study, completed in early April 1954, resulted in a spin-stabilized rocket design known as the Honest John Senior Model 1828. The proposed system featured an improved aerodynamic design and a new Thiokol motor (the 12.5-KS-45,000 JATO unit) having a longer

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[18] (1) Ltr, DAC to CG, RSA, 20 Aug 53, sub: Transmittal of HJ Sr Design Study Proposal (DAC Rept No. SM-14886). HJ R&D Case Files, Box 14-8, RHA AMSC. (2) MFR, Rkt Br, R&D Div, OCO, 20 Nov 53, sub: HJ Sr Briefing. ORDTU File, Oct - Dec 53, FRC.

[19] (1) Ibid. (2) Ltr, OO 471.9/2493, CofOrd to CG, RSA, 30 Nov 53 sub: HJ Sr FS. ORDTU File, Oct - Dec 53, FRC. (3) Ltr, DAC, thru ROO, DAC, to CofOrd, 17 Mar 54, sub: HJ Sr Study. ORDTU File, Mar - May 54, FRC. (4) Notes on HJ Sr, Rkt Br, R&D Div, OCO, 29 Jun 54. ORDTU File, Jun - Aug 54, FRC.

[20] Funds were obligated on 18 November 1953 under Supplement 14 to Contract DA-04-495-ORD-22. (1) Status Rept of Allocations of Proc and R&D Contr Actv, 26 Nov - 5 Dec 53, LAOD. (2) Memo, Chf, Rkt Dev Div, RSA, to Chmn, Pur Asg Bd, 7 Oct 53, sub: Req for Pur Asg Bd Action to Issue Stmt of Just for Negotiation of a Contr. Both in HJ R&D Case Files, Box 14-8, RHA AMSC.

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burning time and a lower nominal thrust than the one used in the initial study. The general characteristics and capabilities of the proposed dual-payload system were as follows

	Rocket w/1,170-lb. XW-7 Warhead	Rocket w/Alternate 1,500-lb.Warhead
Gross Weight..................	5,936 pounds	6,269 pounds
Maximum Diameter..............	31.5 inches	31.5 inches
Length........................	365 inches	365 inches
Maximum Range.................	79,200 yards	68,800 yards*
Minimum Range.................	16,900 yards	14,160 yards
Accuracy at 45,000-yard Range:		
W/Perfect Altitude Fuzing--		
Range Probable Error.......	300 yards	290 yards
Azimuth Probable Error.....	276 yards (6.1 mils)	283 yards (6.3 mils)
W/Perfect Time Fuzing--		
Range Probable Error.......	205 yards	186 yards
Azimuth Probable Error.....	276 yards (6.1 mils)	283 yards (6.3 mils)
Altitude Probable Error....	138 yards	141 yards

*Under adverse firing conditions, such as head winds, grain temperature variations, etc., the nominal range would be 60,000 yards.

Preliminary engineering studies indicated that the useful minimum range of the Honest John Senior could be readily reduced to about 5,000 yards by the use of aerodynamic drag attachments. (Patterned after the Demijohn, this short-range version of the Senior John was dubbed the Demi-Senior.) The Senior John would be a free, unguided rocket and as such would retain all the advantages of simplicity inherent in the standard (M31) Honest John. Since the rocket would be achieved with a weight increase of less than 400 pounds over the M31 and with no appreciable increase in length, it could be launched from the existing M289 self-propelled launcher with a very minor modification.[21]

[21] DAC Rept No. SM-18350, 1 Apr 54, sub: HJ Sr Preliminary Design Proposal, pp. 33-34, 43, 46-48, 74-80, 83-86. RSIC.

[redacted]

(U) Hence, for a slight increase in gross weight and a correspondingly small increase in production cost, a rocket could be furnished having more than twice the range of the M31 with the conventional warhead and nearly three times the range with the atomic warhead. When fully developed, the Senior John/Demi-Senior system would provide effective close support coverage and excellent overlap at maximum range with both the Corporal and Redstone missiles. It would also provide a suitable replacement for the Basic Honest John whose effective range was limited to 27,500 yards.[22]

(U) A detailed study of the Senior John proposal indicated that the weapon system was technically feasible and could be developed through the system test phase in about 36 months at an approximate cost of $10 million. In view of the advantages offered by the omnirange missile and the extent of engineering work yet required to perfect the Basic Honest John, the Chief of Ordnance recommended, in August 1954, that the Army Field Forces establish a firm requirement for development of the Senior John and that the Honest John program be reoriented accordingly. In the latter connection, he proposed to take one of two possible courses of action. If a firm requirement for the Senior John should materialize during FY 1955, further effort to improve the Honest John would be discontinued. But if development of the Senior John should be deferred until FY 1956 or later, studies to improve the Honest John would be continued and perhaps accelerated.[23]

(U) When this proposal was made in August 1954, the first eight reduced-strength Honest John batteries had been equipped with the interim M31 rocket; the initial phase of the product improvement program had been

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[22]Notes on HJ Sr, Rkt Br, R&D Div, OCO, 8 Oct 54. ORDTU File, Sep - Dec 54, FRC.

[23]DF, 00/4C-16725, CofOrd to ACofS, G-4, 10 Aug 54, sub: Time and Dollar Scd - HJ Sr, and incl thereto, Planning Scd for HJ Sr Through Sys Test. ORDTU File, Jun - Aug 54, FRC.

completed; and action had been taken to classify the modified M31A1 rocket as standard type. The design changes incorporated in the latter model corrected some of the major deficiencies; however, a suitable conventional warhead was yet to be developed and further design refinements were necessary to improve system performance, particularly in the areas of effective range, accuracy, and operating temperature limits.[24]

(U) The tactical suitability of the Honest John system had been established to the user's satisfaction in a series of weapon system tests during the first few months of 1954. Though conducted under simulated tactical conditions, these tests indicated that a satisfactory degree of accuracy had been attained and that the weapon system was acceptable for field artillery operations.[25] Subsequent test reports, however, contained conflicting data on dispersion of the Honest John and created some uncertainty as to the accuracy that could be expected under combat conditions. In October 1954, with overseas deployment already underway, the Army General Staff called for a briefing on the accuracy of the weapon system and the extent of R&D effort required to bring performance within the limits specified in approved military characteristics.[26]

(U) The need for an immediate and intensive R&D program to improve the accuracy of the Honest John system was confirmed by the presentation given at the Pentagon on 12 November 1954. A few weeks later, the Deputy Chief of Staff for Logistics (DCSLOG) directed the Chief of Ordnance to initiate, on a 1A priority, an accuracy improvement program for the Honest John and to submit proposed time and dollar schedules by the middle of December 1954. At the same time, plans for development of the Honest John Senior were shelved and the $1.35 million earmarked for this

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[24] Cagle, History of the Basic (M31) Honest John Rocket System, 1950 - 1964, pp. 93-95, 97-98, 109-111.

[25] Ibid., p. 105.

[26] DF, DCSLOG to CofOrd, 20 Oct 54, sub: HJ Accuracy. ORDTU File, Sep - Dec 54, FRC.

program in the FY 1955 budget was made available for other R&D application, "including the HONEST JOHN accuracy improvement program."[27]

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(~~C~~) Establishment of Development Plan (U)

(U) In compliance with the directive from the DCSLOG, the Chief of Ordnance requested that the Redstone Arsenal and the Douglas Aircraft Company formulate a program plan designed to bring the accuracy of the Honest John system within limits specified in the approved military characteristics. He emphasized that major redesign or increase in complexity should be avoided and that first priority should be given to those areas of improvement that would have the greatest chance of improving system accuracy. Wherever possible, consideration was to be given to design changes that would be applicable to existing stockpile missiles and to production missiles on a field modification basis. The proposed plan was to include time and dollar scales, and a request for additional funds required to carry the program through an appropriate systems test.[28]

U
(~~C~~) Statement of the Problem (U)

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(~~C~~) The failure of the Basic Honest John System to measure up to the desired performance standards could be attributed to a combination of circumstances completely beyond the control of the development contractor and the system manager. Among these were (1) the freezing of the aerodynamic design in the early stages of development (late 1951)

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[27] (1) DF, same to same, 29 Nov 54, sub: HJ Imprv Prog. (2) 1st Ind, 00/4UI-54000, CofOrd to Dist Chf, LAOD, 29 Nov 54, on Ltr, LAOD to CofOrd, sub: Contr DA-04-495-ORD-22, DAC, HJ Sr Prog. Both in ORDTU File, Sep - Dec 54, FRC.

[28] (1) Ltr, 00/4C-25861, CofOrd to CG, RSA, 8 Dec 54, sub: HJ Imprv Prog. (2) TT, same to same, 6 Dec 54. Both in ORDTU File, Sep - Dec 54, FRC.

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before the full potential of the rocket design could be investigated; (2) the lack of adequate R&D rounds to evaluate the technical suitability of the weapon; (3) the phase-in of industrial activity before completion of developmental tests; and (4) the lack of firm technical guidance on user requirements. All of these conditions naturally had a profound effect on the end product, but those presenting the greatest problem were the lack of technical guidance and the pressures imposed by the crash-type development schedule.[29]

(U) From the beginning of the program in October 1950 through late April 1952, the contractor had only a tentative set of military characteristics which called for a rocket having a range of 20,000 yards and a circular probable error (CPE) of 360 yards (deflection error 10 mils; range error 300 yards). When the detailed statement of "proposed" military characteristics became available in late April 1952, nearly all of the 74 R&D rockets had been built, about half of them had been fired, and the initial industrial contracts were being negotiated. The belated statement of weapon system requirements, published in November 1952 and approved by the General Staff in February 1953, specified a desired accuracy of 200 yards CPE and a required maximum range of 30,000 yards.[30]

(U) The standard M31 rocket initially issued to the troops in 1954 fully met the original requirements for the rocket but fell short of the performance specified for the complete system. An analysis of the special 20-round accuracy program, conducted in mid-1953, indicated a range PE of 183 yards, a deflection PE of 132 yards, and a CPE of 274 yards. These special rounds were fired from the fixed-base R&D launcher under carefully controlled conditions and therefore reflected the accuracy of

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[29] Cagle, History of the Basic (M31) Honest John Rocket System, 1950 - 1964, pp. 54, 71-72, 74.

[30] (1) Ibid., pp. 66-68. (2) Also see OTCM's 33836, 2 Aug 51; 34490, 20 Nov 52; and 34615, 12 Feb 53. RSIC.

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the <u>rocket</u> only.[31] In the 24-round <u>system</u> test, conducted early in 1954, the dispersion errors nearly doubled those shown for the rocket alone, thus indicating a tactical system CPE of between 400 and 600 yards.[32]

U (~~C~~) The desired 200-yard CPE obviously had not been attained; however, the results of the system test were by no means definitive. The size of the round sample was too small to permit a statement of accuracy with a high degree of confidence. Moreover, because of the crash nature of the program, little data had been gathered on the dispersion factors attributable to the various system components, and the magnitude of such factors had not been determined. In addition, the lack of time and funds had precluded the investigation of potential component improvements which would have resulted in a more accurate and more tactically suitable weapon system. Among these were improvements in spin programming and missile stability; refinement of motor design parameters; investigation of lightweight tactical launcher designs to increase system mobility and ease of handling; and consideration of short, lightweight launching beams to lower the launcher silhouette and permit greater airborne capability. It was also evident that considerable effort would be necessary to effect an optimum system for measuring surface winds and to devise a quicker, more accurate method of inserting the wind corrections into the launcher.[33]

U (~~C~~) <u>Plan for System Improvement</u> (U)

U (~~C~~) On the basis of the foregoing considerations and recent exploratory research in advanced techniques and system concepts, the Redstone

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[31] DAC Rept SM-14910, 5 Oct 54, sub: A Dispersion Analysis of HJ Rds 132 - 151. RSIC.

[32] (1) Ltr, CG, RSA, to CofOrd, 13 Dec 54, sub: Ord Proj TU2-1029, Imprv Prog for HJ Sys. ORDTU File, Sep - Dec 54, FRC. (2) DF, CofOrd to CRD, OCofS, 18 Jan 55, sub: HJ Imprv Prog. ORDTU File, Jan - Apr 55, FRC.

[33] <u>Ibid</u>.

Arsenal and the Douglas Aircraft Company each prepared a proposed plan for improvement of the Honest John system. Both of the proposals placed primary emphasis on improvements in tactical accuracy of the system, but also give important consideration to certain proven design changes aimed at improving the effective range and logistic capabilities. The Redstone Arsenal sent the Chief of Ordnance a preliminary outline of the overall plan, together with time and dollar schedules, in mid-December 1954.[34] This advance information was followed, in early January 1955, by a preliminary Douglas Aircraft proposal, which described an improved Honest John "B" system (DAC Model 1866).[35]

(U) The Chief of Ordnance sent the DCSLOG a preliminary outline of the proposed improvement program in late December 1954, and supplemented this with a more detailed outline in January 1955. The recommended program was oriented so that, upon completion, the Honest John system would be more accurate at greater range, easier and safer to handle, simpler and easier to maintain, and cheaper and easier to produce. It consisted of two major phases covering a period of 24 months (see Tables 2 and 3) and costing about $3.4 million. Based on the guidance contained in the General Staff directive of 29 November 1954, it had been assumed that the entire $1,350,000 then earmarked for development of the Honest John Senior would be available for the accuracy improvement program. However, an R&D budget reduction later in 1954 reduced the original allocation to $1,150,000. In this connection, the Chief of Ordnance noted that the improvement program probably could be implemented as planned within the limits of reduced funding, but warned that a complete reappraisal of the program would be necessary if further reductions should be made. Pending final approval of the recommended program and

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[34] Ltr, CG, RSA, to CofOrd, 13 Dec 54, sub: Ord Proj TU2-1029, Imprv Prog for HJ Sys. ORDTU File, Sep - Dec 54, FRC.

[35] DAC Rept No. SM-18695, 7 Jan 55, sub: Honest John "B" (DAC Model 1866) - A Preliminary Evaluation of an Honest John System Improvement Program, p. 1. RSIC.

Table 2—(U) Proposed Honest John Improvement Program

Phase I. Research Test Program

1. Determine the source and magnitude of system errors contributing to dispersion.
2. Determine level of rocket stability to reduce rocket sensitivity to wind and thereby increase accuracy.
3. Determine optimum spin rocket design to increase accuracy.
4. Continue surface wind studies.
5. Determine optimum motor design parameters.
6. Evaluate launcher dynamics.
7. Study of guidance length as it affects dispersion.
8. Determine motor temperature corrections for revised firing table.
9. Continue launcher modification program to effect greater mobility, increased ease and safety of handling, and weight reduction. This portion of the program to include continued investigation of the lightweight launching beam and problems associated with remote laying of the launcher.
10. Continue ancillary equipment modification program.
11. Studies leading to improvement of fuzing techniques for air-burst warheads.

Phase II. Improved Honest John Design and Test Program

1. Design improved rocket based on data from Phase I.
2. Flight tests of improved rocket - determination of range table data, design checks, etc.
3. Launcher and ancillary equipment tests.
4. System tests.

Note: The two phases will overlap; i.e., data from Phase I will be immediately applied to Phase II development as appropriate. The time scale envisaged for the complete program is 24 months.

SOURCE: DF, CofOrd to CRD, OCofS, 18 Jan 55, sub: HJ Imprv Prog.

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Table 3—Time Schedules for Honest John Improvement Program

Item	Description	MONTHS (1–24)
I	Contracts, Basic Planning & Proc. Finalization	
II	Rocket Design	Fin-Spin; Dev Rounds; Final Rounds
III	Procurement: Rocket & Motor	
IV	Testing: a. Preliminary	
	b. Development	
	c. Final Dev	
	d. System Tests	
V	Add. Motor Dev: a. Design	Applied to Desired Motor
	b. Longer Grain	
	c. Fiberglass	Destruct. & Static Tests
	d. New grain: (1) Design	Design; Redesign
	(2) Scale Tests	
	(3) Full Scale Tests	
VI	Wind Studies	
VII	Launcher and Ancillary Equip.	Design; Fabrication; Testing

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reallocation of funds from the Senior John project, the Douglas Aircraft Company initiated preliminary Phase I studies using funds available in its basic R&D contract.[36]

(U) Early in February 1955, the Army General Staff approved the proposed program with scope and objectives indicated in Tables 2 and 3. Accordingly, the Rocket Branch, R&D Division, OCO, took immediate steps to establish a final detailed plan and to obtain proposals for research studies under Phase I.[37]

[36](1) DF Cmt 2, CofOrd to DCSLOG, 23 Dec 54, on DF, DCSLOG to CofOrd, 29 Nov 54, sub: HJ Imprv Prog. (2) DF, CofOrd to CRD, OCofS, 18 Jan 55, sub same. ORDTU File, Jan - Apr 55, FRC.

[37]DF Cmt 2, CRD, OCofS, to CofOrd, 2 Feb 55, sub: HJ Imprv Prog. The contents of this document and actions taken to implement the program are recorded in handwritten notes on the Honest John Improvement Program, September 1955. ORDTU File, Sep - Dec 55, FRC.

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CHAPTER III

U (~~S~~) PROGRAM PLANS AND SCHEDULES (U)

(U) Work on the Honest John Improvement Program officially began early in 1955 and continued on an intermittent basis through the next several years. The improved techniques and system concepts investigated during the 1952 - 54 period had substantially advanced the state of the art in the large-caliber rocket field and provided a ready technical approach for the advanced weapon system. Unfortunately, the advantages that accrued from this research effort were neutralized by irresolute program direction and vacillating financial support. As a result of continued funding compromises and repeated re-examination and reversal of decisions by the Army General Staff, the scope and objectives of the rocket development effort varied from no program at all, to a modified version of the M31 rocket, to a completely new system. Consequently, the time required to develop the improved XM-50 rocket more than doubled the original estimate of 24 months, and the complete tactical system was not available in quantity until the late spring of 1961. Hence, this chapter traces the changes in program plans and schedules through FY 1963, and examines some of the problems encountered in the implementation of such plans.

U (~~C~~) Revision of the Original Plan (U)

U (~~C~~) The need for a sharp reduction in the scope of work originally envisaged became evident in February 1955, shortly after the DCSLOG approved the initial plan. This plan had consisted essentially of two major phases covering an estimated development time of 24 months and costing about \$3.4 million. The proposed objectives, development time, and estimated cost had been predicated on the assumption that the entire \$1,150,000 remaining in the Honest John Senior allocation would be made

available, and the DCSLOG had approved the plan on that basis.[1] However, in late February 1955—before the final detailed plan could be formulated and before firm contractor proposals could be completed—the Department of the Army directed a further reduction of $400,000 in the Senior John allocation, leaving a balance of $750,000. Of this amount, $30,000 was allocated to Program 5700 for Arsenal overhead in support of the project, and $720,000 was transferred to the Honest John Improvement Program increasing the net funds available for the latter from $500,000 to $1,220,000. The program included both the rocket development under Project TU2-1029 and the launcher effort at the Rock Island Arsenal previously funded directly under Project TU2-3008. Funds for the improvement program were distributed as follows: Redstone Arsenal expenses, $70,000; Rock Island Arsenal (launcher), $300,000; and the rocket development contractor, $850,000.[2]

(U) The R&D Division, OCO, held several conferences in an attempt to establish a revised plan that would meet the desired objectives in view of the drastic fund reduction, or alternatively, lead to a determination of the value to the Army of a reduced improvement program based on funds available. A final decision on the revised program was not reached until early August 1955. Meanwhile, the Redstone Arsenal proceeded to establish a detailed outline of the original plan as approved in early February 1955.

(~~C~~ U) On 17 February 1955, officials of interested agencies[3] met at the Redstone Arsenal to work out a suitable development program from

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[1]<u>See</u> above, pp. 60-63.

[2](1) Ord Corps Planning Scd No. 5040-5412-13-426, Amdt 3, CofOrd to CG, RSA, 23 Feb 55. (2) Ord Corps Planning Scd No. 5040-5412-13-491, Amdt 1, same to same, 24 Feb 55. Both in ORDTU File, Jan - Apr 55, FRC.

[3]Including the OCO, White Sands Proving Ground, Douglas Aircraft Company, Evans Signal Corps Laboratory, and Redstone Arsenal.

proposals prepared by the Arsenal and the Douglas Aircraft Company.[4] During the conference, an attempt was made to plan the program according to the Douglas Aircraft proposal, but the estimated cost of $5 million exceeded the funding provisions.[5] The Redstone Arsenal proposal provided for essentially the same improvements for $3,200,000. The basic difference between the two plans was the number of flight rounds required—164 under the Douglas plan and 82 under the Arsenal plan. This accounted for the monetary difference, but the difference in flight rounds required was attributed to the basic approach considered in the two proposals.

(U) The Redstone Arsenal based its sample size on the fact that the improvement program could benefit from the existing Honest John program, that a weight change of 400 to 800 pounds could be correlated in the same manner as previous changes in warhead weight, and that the improved design would be essentially a modification of the existing design. In contrast, the Douglas Aircraft Company considered the improved round to be a completely new design, concluding that there was not enough known about the round to substantiate theoretical design techniques and that there would be little or no correlation between the existing round and the proposed design. Unable to reach a decision on a suitable compromise between the two plans, the OCO representative asked the Redstone Arsenal to evaluate the problem and submit a recommended solution to the Chief of Ordnance for final approval.[6]

(U) The approach recommended by the Redstone Arsenal in March 1955 was based on a program that would first determine the magnitude of major

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[4] These proposals had been used as a basis for the preliminary plan submitted to the General Staff in January 1955 and approved early in February. See above, pp. 60-63.

[5] The OCO representative stated that the program was to be completed in 24 months and within the following funding provisions: FY 1955, $950,000; FY 1956, $1,395,000; FY 1957, $1,200,000—total $3,545,000.

[6] Min of RSA Conf, 17 Feb 55, as summarized in RSA Rept No. 3M51P, 11 Mar 55, sub: Preliminary Honest John System Improvement Program, pp. 1, 2, 26. RSIC.

sources of error through an 18-round variable stability (fin-spin) test, then provide an improved rocket design for the maximum error reduction. It included the development of a higher impulse motor propellant with a faster burning rate and wider operating temperature limits; an improved launcher having a shorter guidance rail of 14 to 15 feet; and improved ancillary equipment. The recommended program would cost about $3.5 million and require 26 months for completion. It would provide a rocket with improved accuracy and extended temperature limits of -40°F. to 120°F., and ground equipment that would be more suitable for field use. Moreover, the improved rocket would be compatible with the existing Honest John equipment.[7]

(U) Confirming decisions reached at the Honest John Steering Committee Meeting on 16 - 17 March 1955, the Chief of Ordnance approved the recommended plan early in April and instructed the Redstone Arsenal to proceed without delay to implement the program. He directed the Arsenal to obtain firm proposals from the Douglas Aircraft Company on the fin and spin bucking program, including the design and procurement of three different size fins for research flight tests, using Type II (M31) rockets with 1,500-pound ballast warheads. Launcher studies were to be continued by the Rock Island Arsenal under the technical control of the Redstone Arsenal. The latter was to undertake preliminary work on motor redesign without the employment of a contractor except for the procurement of necessary metal parts.[8]

(U) Although the foregoing program represented a slight cost increase over the original estimate, it appeared that the scope of work could be supported with available funds. However, when the fund reduction became effective, the amount available for the improvement program

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[7] RSA Rept 3M51P, pp. 10-12.

[8] (1) Ltr, 00/5C-7213, CofOrd to CG, RSA, 1 Apr 55, sub: HJ Imprv Prog. (2) Ltr, 00/5C-7814, same to same, 8 Apr 55, sub: HJ Imprv Prog - RSA Rept No. 3M51P dated 11 Mar 55. Both in ORDTU File, Jan - Apr 55, FRC.

had been reduced from $3,545,000 to $3,000,000.[9] Moreover, the preliminary contractor proposals received in late March 1955 indicated that the planned scope of work would cost about $4.75 million—an increase of $1.35 million over the original estimate and $1.25 million over the latest Redstone estimate. This increased cost was attributed to (1) higher contractor costs than originally estimated; (2) an increase in the minimum developmental flight tests from 64 to 92 rounds; (3) the inclusion of the Demijohn short-range capability for both the basic and improved rockets; (4) the inclusion of feasibility studies on a hybrid fuze to improve system accuracy; and (5) the development of a new launcher and handling equipment to include fabrication of one prototype set.

U
(~~C~~) While the OCO investigated alternate approaches to bring the scope of work within limits of available funds, the Redstone Arsenal proceeded to implement the program as approved in early April. By mid-May 1955, wind tunnel studies on fin sizes had been completed and the first flight tests of rockets with modified fins were scheduled to begin in June. Also, the preliminary design analysis on the new motor had been completed and feasibility studies on the new launcher were nearing completion.[10]

U
(~~C~~) In late May 1955, just as the Redstone Arsenal was preparing to extend the scope of work beyond the research phase, the program guidance of early April 1955 was rescinded. During a meeting at the Douglas Aircraft Company on 25 May, Lt. Col. A. L. Stevens of the OCO announced that the scope of the existing program was being revised downward to bring it within funding limits. Specifically, the $360,000 then earmarked for the motor improvement program would have to be diverted to

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[9] The new funding program allotted $1,050,000 for FY 1955, $1,250,000 for FY 1956, and $700,000 for FY 1957. See above footnote 5, p. 67.

[10] Notes on the HJ Improvement Program, Sep 55. ORDTU File, Sep - Dec 55, FRC.

support the short-range Demijohn program and development of the improved launcher and ancillary equipment. As a result, the scope of the rocket improvement effort would be limited to minor modifications of the standard M31A1 rocket; development of the new motor would be abandoned; and all rocket redesign would be eliminated with exception of changes in the fin and spin system to reduce dispersion error. The Chief of Ordnance confirmed this reduced level of effort in late June 1955 and directed the Redstone Arsenal to reorient the project accordingly.[11]

U (Ø) The revised plan, approved in early August 1955, consisted essentially of the Phase I effort authorized in the initial program. Priority of effort was to be accorded those portions of the program that might be expected to result in improved accuracy for free rocket systems in general. The six areas of effort recommended for the revised program were thus rearranged in the order of assigned priority as follows.[12]

1. Proceed with fin-spin studies to achieve an optimum fin-spin system.

2. Conduct theoretical fuze studies leading to recommendations for a hybrid (combined time-altitude) fuze system.

3. Continue low level wind studies insofar as time and funds permit.

4. Continue short-range Demijohn programs for both the standard and improved rockets.

5. Continue development of improved launcher and handling equipment.

6. Continue correlation of all appropriate ballistic data obtained with similar data from previous Honest John firings in an attempt to improve present firing tables by mathematical and statistical methods.

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[11](1) TT ORDDW-MKD-863, CG, RSA, to CofOrd, 11 Jun 55. (2) Ltr, 00/5C-14212, CofOrd to CG, RSA, 24 Jun 55, sub: HJ Imprv Prog. Both in ORDTU File, May - Aug 55, FRC.

[12]DF, 00/5C-14859, Maj Gen Leslie E. Simon, ACofOrd, to CRD, OCofS, 8 Jul 55, sub: HJ Imprv Prog; and Cmt 2, Brig Gen Andrew P. O'Meara, CRD, OCofS, to CofOrd, 4 Aug 55. ORDTU File, May - Aug 55, FRC.

U
(~~C~~) In mid-August 1955, before the detailed plan for the revised program could be completed, the Redstone Arsenal learned that recent flight tests of the Demijohn configuration had proved unsuccessful because of a serious vibration problem with the special warhead. It also learned that the standard Honest John with a modified special warhead would provide the desired short-range capability except for a nebulous masking problem.[13] In view of the consequent suspension of the Demijohn program and the fact that little, if any, improvement in system accuracy would be possible under the reduced level of effort, the Arsenal sent the OCO an alternate project proposal to have the rocket motor program reinstated.

U
(~~C~~) The alternate proposal, submitted to the Chief of Research and Development (CRD) in late October 1955, suggested that the funds then allotted to the Demijohn and launcher programs be used for development of an optimum motor. In support of this recommendation, the Chief of Ordnance emphasized that the reduced level of effort would result in questionable system accuracy and that the desired range accuracy improvements could only be achieved by development of an entirely new motor design. At the same time, he recognized that termination of the launcher program would leave the system with only the XM-289 launcher and the needed improvements being designed into the new XM-386 model would thus be sacrificed.[14] In this view, he suggested that with the Demijohn funds and an additional $400,000 the motor program could be undertaken and work could be continued on the improved launcher. This approach

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[13](1) Ltr, DAC to CG, RSA, 10 Aug 55, sub: Status Rept on HJ Short-Range Capability. (As cited in RSA Rept No. 433, 25 Dec 55, sub: Project Plan for Development of an Improved Honest John System. RSIC.) (2) <u>Also see</u> Cagle, <u>History of the Basic (M31) Honest John Rocket System, 1950 - 1964</u>, p. 130.

[14]Among these improvements were a 10,000-pound weight reduction, reduced emplacement and displacement time, improved jack and leveling system, and easier and simpler maintenance.

[redacted]

would provide a system having maximum accuracy and greater range in addition to improved launching and handling equipment.[15]

(U) During a conference held at the CONARC on 15 November 1955, a representative of the OCO gave a briefing on the foregoing proposal and on the status of the improvement program. All agencies concerned, including the CONARC, agreed that the development of a new motor would be "very desirable." Yet none was willing to sacrifice the improved launching equipment, and the additional funds needed to carry both programs were not immediately available. The Chief of Ordnance thus directed the Redstone Arsenal to implement the reduced level of effort as previously approved.[16]

(U) The detailed project plan, published in late December 1955, provided for the prosecution of the six areas of effort authorized in early August 1955.[17] The objectives of the program were threefold: (1) to reduce the magnitude of errors in the Basic Honest John System to the maximum extent possible within limits of reduced funding; (2) to take advantage of certain proven design changes applicable to the rocket, launcher, and auxiliary equipment that would contribute to increased system mobility, reliability, and simplicity; and (3) to insure that the resulting design changes would not prohibit interchangeability between the standard and improved systems. The modified XM-31E2 rocket would use the standard M6A1 motor with some minor changes and the improved fin-spin system.[18] The funding requirements for the reduced

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[15](1) Ltr, CG, RSA, to CofOrd, 8 Nov 55, sub: Ord Proj TU2-1029, HJ Imprv Prog [initially submitted in draft form in Oct 55]. (2) DF, 00/5C-23752, CofOrd to CRD, OCofS, 28 Oct 55, sub: same. Both in ORDTU File, Sep - Dec 55, FRC.

[16](1) Ltr, CG, CONARC, to CofOrd, 28 Nov 55, sub: Arty Rkt Dev. (2) Ltr, 00/5C-25372, CofOrd to CG, RSA, 18 Nov 55, sub: Ord Proj TU2-1029, HJ Imprv Prog. File same.

[17]See above, p. 70.

[18]The rocket later developed with an entirely new power plant was designated as the XM-50.

[redacted]

effort totaled $2,877,500. Of this amount, $1,331,847 was then available, $794,153 would be required for the remainder of FY 1956, and the balance of $751,500 was to be provided for completion of the program in FY 1957.[19]

U
(~~C~~) Reinstatement of the Motor Program (U)

U
(~~C~~) The Redstone Arsenal had scarcely completed the detailed plan of the reduced program when word came that sufficient funds had been found to support the development of an improved propellant grain for the Honest John motor. Early in February 1956, the Rocket Branch of the R&D Division, OCO, announced that $1.8 million in FY 1956 procurement and production (P&P) funds could be made available by the Ordnance Ammunition Command as a dividend yield accrued during production loading and assembly operations at the Radford Arsenal. If approved, the proposed plan would delay completion of the improvement program for 9 months—from April 1957 to January 1958.[20]

U
(~~C~~) The Redstone Arsenal had established 2 February 1956 as the deadline for changing the existing development plan; but on that date it learned that final approval of the extended effort would be delayed. With the fabrication of standard M31A1 rocket components about to begin, the Arsenal suggested that work on the rocket portion of the program be suspended unless a definite decision on the extended effort would be available by 13 February.[21] The Chief of Ordnance advised the Arsenal, on 9 February, that work should be temporarily suspended pending a final decision, but indicated that the suspension would be lifted and work

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[19]RSA Rept No. 433, 25 Dec 55, sub: Proj Plan for Dev of an Improved HJ Sys, pp. 4-7, 45.

[20]MFR, S. S. Draeger, ORDTU, 1 Feb 56, sub: HJ Imprv Prog. ORDTU File, Jan - Apr 56, FRC.

[21]TT ORDDW-MKP-2297, CG, RSA, to CofOrd, 8 Feb 56. File same.

resumed if a firm decision were not forthcoming by 17 February.[22] Throughout the ensuing 3 months, however, guidance from higher headquarters remained in a state of flux, and instructions to reinstate the motor program did not reach the Arsenal until early June 1956. Meanwhile, work continued on the improved XM-386 launcher and on the new helicopter-transportable launcher (HTL) later designated as the XM-33. The Ordnance Corps had initiated development of the lightweight HTL in mid-February 1956.[23]

(~~C~~ U) Under the extended scope of effort approved in mid-May 1956, primary emphasis was to be placed on improvement of range accuracy through the development of an improved rocket motor grain and the reorientation of the fin-spin program to reflect changed motor performance. In the area of secondary objectives, development was to be oriented first toward extending the maximum range to 32,000 yards if this could be done with no increase in weight over the M31A1 rocket, and, secondly, toward achieving the maximum decrease in rocket weight consistent with the desired maximum range. These secondary objectives, however, were not to interfere with the primary aim of reducing range dispersion; and the resulting rocket was to be compatible with both the standard M289 and improved XM-386 launchers, as well as the lightweight XM-33 launcher. Other areas of effort would be continued as previously approved: viz., low level wind studies in cooperation with the Signal Corps; theoretical fuze studies; and development of the improved launchers and handling equipment.[24]

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[22] TT, CofOrd to CG, RSA, 9 Feb 56. File same.

[23] (1) DF, CRD, OCofS, to CofOrd, 15 Feb 56, sub: Initiation of HJ Hel Transbl Lchr Prog. File same. (2) Also see above, p. 48.

[24] (1) DF, CRD/C-7113, CRD, OCofS, to CofOrd, 14 May 56, sub: HJ Imprv Prog. (2) Cmt 2, CRD/C-2931, same to same, 3 Apr 56, on DF, OO/6S-2291, CofOrd to CRD, OCofS, 1 Mar 56, sub: same. (3) TT, OCO to CG, RSA, 8 May 56, sub: HJ Imprv Prog, TU2-1029, as Reoriented to Incl Mtr Grain Imprv. (4) Ltr, same to same, 4 Jun 56, sub: HJ Imprv Prog. All in ORDTU File, May - Aug 56, FRC.

U (~~S~~) In the course of the paper exercises leading to approval of the extended effort, the Army General Staff indicated that a 9-month delay in completion of the improved rocket would be acceptable on the basis of the expected decrease in range error, but emphasized that no delay would be tolerated in making the improved launching equipment available.[25] In the proposal for reinstatement of the motor program, submitted in early March 1956, the Chief of Ordnance had stated that reorientation of the program would delay completion of the improved rocket from April 1957 to January 1958, or about 9 months.[26] However, the time lost awaiting firm guidance resulted in a further extension of the estimated completion date from January 1958 to June 1958, or a total delay of 14 months from the original target date of April 1957. Development of the XM-386 launcher and auxiliary equipment was scheduled for completion in time for engineering-user tests during the first quarter of 1957. Test of the XM-33 HTL was scheduled to begin in October 1957. The improved launching systems would thus be developed and qualified for field use many months in advance of the improved rocket.[27]

U (~~S~~) <u>Implementation of Commodity Plans</u> (U)

U (~~C~~) The XM-386 launcher program progressed essentially on schedule and the equipment was classified as standard type in September 1957.[28] The XM-33 launcher program was delayed by a change in required delivery capabilities. It was type classified as the Chopper John system in early

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[25]Ltr, 00/6C-4937, CofOrd to CG, RSA, 5 Mar 56, sub: HJ Imprv Prog, TU2-1029. ORDTU File, Jan - Apr 56, FRC.

[26]DF, 00/6S-2291, CofOrd to CRD, OCofS, 1 Mar 56, sub: HJ Imprv Prog. ORDTU File, Jan - Apr 56, FRC.

[27](1) Ltr, CG, RSA, to CofOrd, 18 Apr 56, sub: Ord Projs TU2-1029 & TU2-3008, HJ Imprv Prog. File same. (2) TT ORDDW-MKP-2492, CG, RSA, to CofOrd, 11 May 56. ORDTU File, May - Aug 56, FRC.

[28]OTCM 36609, 12 Sep 57. RSIC.

[redacted]

April 1959.[29] As will be noted below, the rocket portion of the Honest John improvement program was hindered by a continuing lack of funds, repeated program terminations and reviews, and shifts in technical approach. The XM-50 rocket was type classified as limited production type in September 1959, but the initial tactical units were not accepted for field issue until May 1961. It was reclassified from limited production to Standard A type in December 1962.[30]

U
(~~C~~) Change in Technical Approach (U)

U
(~~C~~) One of the most damaging delays in the rocket development program resulted from the use of modified XM-31E2 rockets[31] as the research test vehicle for the XM-50 model. During the period 1955 - 57, some 38 modified M31 rockets were expended in delivery system development tests to establish the feasibility of the spin buck system for the improved rocket design. On the basis of performance data obtained from these tests, the spin buck technique was adopted and flight tests of the XM-50 rocket, using the new XM-31 motor,[32] began in mid-June 1958. About 32 R&D rounds and 10 months were spent in pursuit of XM-50 development using the spin buck system before it was determined that this approach would not meet established accuracy requirements. In late March 1959, R&D tests of the initial XM-50 design were halted and an accelerated research program was undertaken on an alternate straight spin system.

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[29] OTCM 37036, 2 Apr 59. RSIC.

[30] (1) OTCM 37178, 17 Sep 59. RSIC. (2) HJ Prog Rept, ABMA, May 61, p. 4. (3) AMCTCM 364, 13 Dec 62. HJ/LJ Cmdty Ofc File.

[31] This model was developed during the period June 1955 to May 1956 as a part of the reduced level of effort. See above, p. 72.

[32] To avoid confusion, it should be noted that the model number of the new motor (XM-31) had no direct connection with the Basic M31 Rocket. The latter used the M6 motor and the M7 spin rocket. The final R&D model of the XM-50 rocket used the XM-31 motor and the XM-37 spin rocket.

[redacted]

Delivery system development tests of the modified XM-50 design started in early June 1959.[33]

U (Ø) Readiness Date Extended; Termination Threatened (U)

U (Ø) While the foregoing work was in progress, the weapon system manager encountered other setbacks of an equally retardant nature. During the first half of 1957, the research test phase was delayed 2 months because of a strike at the metal parts contractor's plant, and an additional 4 months because of restrictions imposed on the use of overtime.[34] Toward the end of 1957, as the initial (spin buck) test phase neared completion, it became apparent that the intended Ordnance readiness date[35] of December 1959 could not be met because of design problems in the rocket motor.[36]

U (Ø) In January 1958, the Army Chief of Staff began a review of the Honest John improvement program to determine whether it should be terminated or continued to completion. To assist the OCO in establishing an official position on continuation of the project, the Redstone Arsenal prepared three alternate plans, each based on a specific funding level. The readiness dates proposed in these plans were (1) Plan A, December 1959; (2) Plan B, with no overtime, May 1960; and (3) Plan B modified to include funding for overtime, March 1960. Plan A was ruled out as

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[33](1) HJ Msl Sys Plan, ARGMA MSP-11, 1 Jun 60, pp. 2-A, 38-D. (2) Also see below, pp. 131-35.

[34]RSA Semiannual Hist Sum, 1 Jan - 30 Jun 57 (2 vols), II, 247. RHA AMSC.

[35]This date is defined as that by which it is planned to furnish the first acceptable complete weapon system to the field and to have all initial capabilities (e.g., trained manpower, training aids, training devices, technical publications, repair parts, equipment, and facilities) needed for sustained supply, maintenance, and other Ordnance support consistent with the plan or program for that weapon system.

[36]HJ Hist Sum, FS thru 30 Sep 58, and Msl Sys Monthly Prog Rept, Oct 58, p. 8.

unrealistic, and funds for overtime were not available. The plan calling for a readiness date of May 1960 was thus the only logical choice. But in the absence of a decision from the General Staff, there was no assurance that the program would be funded beyond FY 1958. At the end of June 1958, the project was still under review and funding guidance for FY 1959 was yet to be received.[37]

(U) Meanwhile, the motor design problem had been solved and the first firing of the XM-50 rocket took place on 17 June. By the end of August 1958, the XM-50 rocket had been successfully flight tested with XM-27 and T-2044 warheads; a number of rounds had been flight tested across the complete range of quadrant elevations (6° to 50°) and temperatures (-30°F. to $+120^{\circ}$F.); and compatibility of the XM-50 rocket with the M386 and M289 launchers had been established. On 4 September 1958, the Ordnance Missile Laboratories of the ARGMA announced the conditional R&D release[38] of the XM-50 rocket. So far, the revised program was on schedule; but to meet subsequent target dates it was essential that FY 1959 funds be provided no later than 1 October 1958. The ARGMA advised the AOMC headquarters, in mid-September, that all effort on the program would be terminated on 1 October unless funds were made available.[39]

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[37] (1) Ibid., pp. 8-9. (2) Summary of Major Missile Programs, ARGMA, 1 Jan - 30 Jun 58, pp. 3-4. (3) OTCM 37143, 6 Aug 59. RSIC.

[38] In the revised development schedule established earlier in the year (viz., XM-50 Rocket Development Program, Plan B, 18 Jan 58), "Conditional R&D Release" was defined as that time in the program when the developing agency could state with a reasonable degree of assurance that no major design changes were anticipated. Subsequent target dates in the plan were May 1959, release of system accuracy statement; October 1959, release of final R&D drawings; May 1960, Ordnance field support readiness.

[39] (1) DF, Dir, OML, thru Control Ofc, to Chf, R&D Div, ARGMA, 4 Sep 58, sub: Ord Proj TW-200 [formerly TU2-1029], Cond R&D Release of XM-50 Rkt. (2) FONECON btwn Mr. Wicker & Mr. Taylor, ARGMA, and Mr. Johnson, AOMC. (As cited in DF, CG, AOMC, to ARGMA Comdr, 30 Sep 58, sub: Improved HJ.)

U
(~~C~~) FY-1959 Funds Delayed; Commodity Plan Revised (U)

U
(~~C~~) The Army Chief of Staff finally decided to complete development of the XM-50 rocket, and the AOMC received instructions to that effect from the Chief of Ordnance in late September 1958.[40] Even so, the funds and authority needed to negotiate contracts for continued services and rocket deliveries were not made available in time to maintain the FY 1959 schedule. In October 1958, the ARGMA received $3.5 million in R&D funds; however, PEMA/S* funds and authority to negotiate contracts were not received until December 1958, and then only $500,000 of the $4.8 million budgeted. The remaining PEMA/S funds to complete the FY 1959 program were not made available until February 1959. At that time, the ARGMA surveyed the damage done to the existing program plan and set about the familiar task of preparing a new one.[41]

U
(~~C~~) In the meantime, the Commanding General of the AOMC received official guidance on the reduced R&D and PEMA/S budget for FY 1960. Convinced that the extremely tight budget situation in FY 1960 would result in a further stretchout of the program, he recommended, in late January 1959, that development effort on the XM-50 rocket be discontinued.[42] Instead of approving this recommendation, the Chief of Ordnance requested, in early March 1959, that the AOMC prepare a 5-year materiel plan for the XM-50 rocket, together with an R&D time phase schedule. In preparing the plan, the AOMC was to use the following

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*Procurement of Equipment and Missiles, Army/in Support of R&D.

[40] TT 001, CofOrd to CG, AOMC, 25 Sep 58. (As cited in DF, CG, AOMC, to ARGMA Comdr, 30 Sep 58, sub: Improved HJ.)

[41] (1) HJ Hist Sum, FS thru 30 Sep 58, and Msl Sys Prog Rept, Oct 58, p. 10. (2) HJ Prog Rept, Nov 58, p. 2. (3) HJ Prog Rept, Dec 58, p. 1. (4) OTCM 37143, 6 Aug 59. RSIC.

[42] AOMC FY 1960 R&D and PEMA/S Directed Level and Requirements Programs, 23 Jan 59. (As cited in Ltr, CG, AOMC, to CofOrd, 20 Mar 59, sub: Prog Plans for the Rkt, 762mm, XM-50.)

basic assumptions and guidelines: FY-1960 PEMA funds would be the first available for industrial procurement; authority and funds for FY-1960 procurement would be furnished by 1 September 1959; and $1.375 million for the FY-1960 R&D program would be approved and released by 1 September 1959. The FY-1960 buy of XM-50 rockets was to be programmed for $22.720 million maximum procurement value, or 25 percent of the annual budget estimate.[43] In submitting the requested plan, in late March 1959, the Commanding General of the AOMC restated his contention that the development effort should be cancelled, adding that submission of the materiel plan "should not be interpreted as a change in position of this Command . . . ."[44]

(U) The revised commodity plan, published by the ARGMA in July 1959, was predicated on the guidelines and assumptions noted above and the 5-year materiel plan, as revised and approved by the OCO on 30 March 1959. The Ordnance readiness date was extended 6 months, from May to November 1960. The weapon system accuracy statement was to be released by mid-August 1959, at which time action would be taken to classify the XM-50 rocket as limited production type. The final R&D drawings for the rocket and XM-86 Adaption Kit were to be released in May 1960, and initial industrial deliveries were to begin 6 months later, in November 1960.[45] These and other key target dates are depicted in Chart 1.

(U) Funding and Technical Problems, FY 1960 (U)

(U) In many respects, the problems and delays encountered in the FY 1960 program duplicated those of the preceding 2 years. The R&D

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[43] TT 007, CofOrd to CG, AOMC, 2 Mar 59.

[44] Ltr, CG, AOMC, to CofOrd, 20 Mar 59, sub: Prog Plans for the Rkt, 762mm, XM-50.

[45] MFR, W. P. Young, ARGMA Control Ofc, 16 Jun 59, sub: Weaponization Plan for Rkt 762mm, XM-50.

UNCLASSIFIED

CHART 1

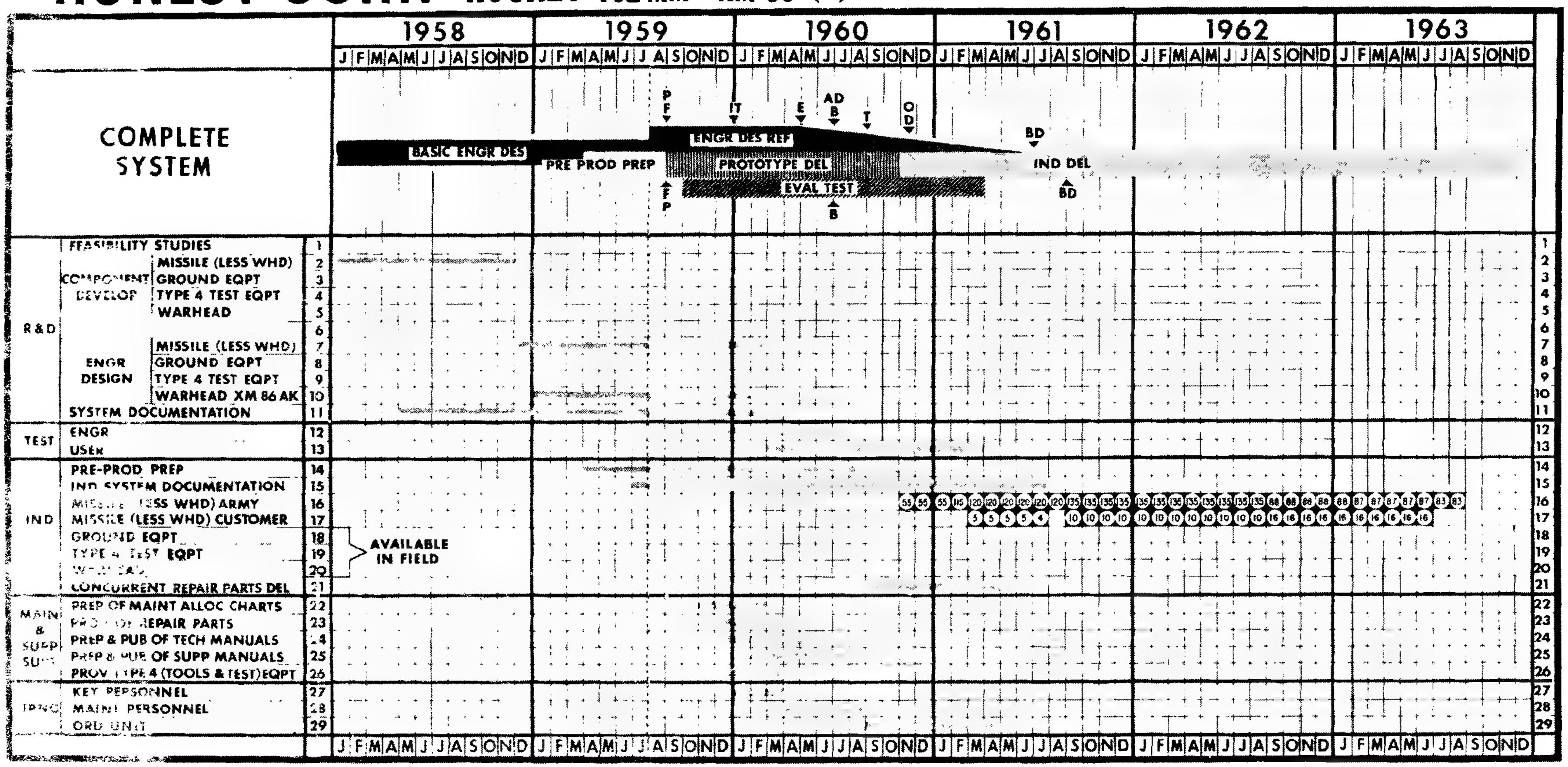
[redacted]

IRCS XMC - 5

ARGMA

HONEST JOHN ROCKET 762 MM XM 50 (U)

WEAPONIZATION PLAN (U)



PLAN
PROGRESS
DELAY
DELAY ELIMINATED
POTENTIAL PROBLEM AREA

AD FUNDED DELIVERY
B BUDGET PROP SUBM FOR FUNDS TO
BD BUDGET PROP SUBM FOR DEL TO
D DEPLOYMENT
DRI DESIGN RELEASE INSP

E IND ECO CONTROL
F FUNDS REQUIRED
IT BEGIN INSTRUCTOR TRAINING
O ORD READINESS DATE
P PROGRAM AUTH REQ

SD SYSTEM DEMONSTRATION
T BEGIN ORD UNIT TRAINING

POINT FOR SPECIAL ATTENTION EXPL IN SUMMARY OF REPORT

ARMY ROCKET & GUIDED MISSILE AGENCY
NO MC 1 HJ 639
DATE 31 JUL 59

[redacted]

funds were not approved and released on the date promised (1 September 1959) and, as the AOMC had warned, the amount budgeted for the fiscal year was patently inadequate to cover contingencies and maintain programmed commitments. The change in technical approach mentioned earlier, coupled with technical deficiencies in the XM-31E2 motor, resulted in additional R&D costs of some $2 million over the amount budgeted.[46] Early in December 1959, the Director of the Ordnance Missile Laboratories reported that development flight tests had been suspended pending correction of the motor problem, and that the delay in receipt of FY-1960 funds would have a "direct impact" on the ability of the development program to recover. "The time required to determine an acceptable solution," he warned, "will be affected by the paucity of funds if the solution becomes more complicated."[47]

(U) Meanwhile, in early August 1959, the Secretary of the Army approved the consolidation of the Honest John Improvement Program under Project 517-07-027 (TW-200).[48] This was followed, in mid-September, by the classification of the XM-50 rocket (without warhead) as limited production type for initial industrial procurement of 1,020 units in FY 1960.[49] The ARGMA released the initial order for XM-50 rockets to the Ordnance Ammunition Command in October 1959. At about the same time, a steel strike caused a delay in the industrial program, and the Ordnance readiness date was extended from November 1960 to January 1961 (Chart 2).[50]

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[46] Proj Sum, Status of HJ Imprv Prog, 12 Feb 60. HJ R&D Case Files, Box 13-563, RHA AMSC.

[47] DF, Dir, OML, to Chf, R&D Div, 9 Dec 59, sub: Ord Proj TW-200, Recm Release of the XM-50 Rkt for Engr Test. File same.

[48] OTCM 37143, 6 Aug 59. RSIC. (The Honest John program had previously consisted of two separate projects: TU2-1029 [rocket], and TU2-3008 [launcher & handling equipment].)

[49] OTCM 37178, 17 Sep 59. RSIC.

[50] HJ Prog Rept, Oct 59, pp. 2, 11.

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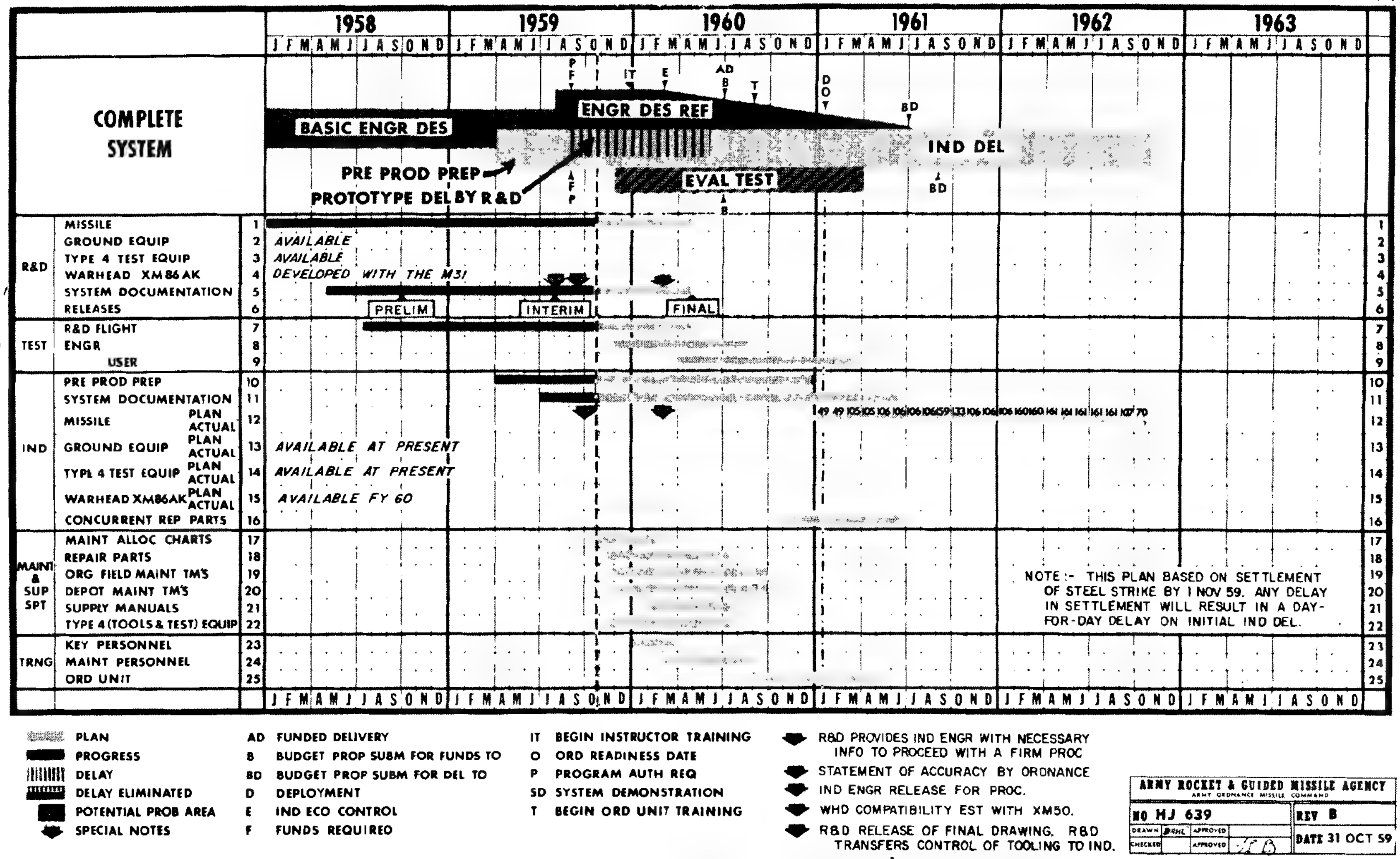
CHART 2

HONEST JOHN ROCKET 762mm XM50

ARGMA RCS XMC - 5

COMMODITY PLAN (U)



[redacted] UNCLASSIFIED

(U) In late 1959, R&D funds were almost exhausted; and, by early 1960, it appeared that development of the XM-50 rocket would have to be suspended. As a result of the aforementioned technical problems, the limited funds programmed for the FY 1960 effort had been expended; nearly a million dollars had been reprogrammed from other projects (the Littlejohn and Lacrosse); and a request had been submitted for $2.083 million in emergency (FY 1960) funds. The latter amount, together with the $100,000 guidance for FY 1961, was expected to be sufficient to complete the rocket development program.[51]

U
(~~C~~) Pending receipt of the emergency FY-1960 funds, the XM-50 rocket development effort was continued from January to 1 March 1960 by the expedient use of funds that had been programmed for hardware procurement. In March, funds were received to carry the program through May 1960; and in June, the effort was funded through mid-August 1960.[52] The RDTE* funds received and obligated in FY 1960 totaled $4.737 million. The PEMA program authority received amounted to $43.498 million, including $18.089 million from other customer orders.[53] The CRD, in April 1960, had authorized an increase in the limited production quantity of the XM-50 rocket from 1,020 to 2,000. This increased quantity was to cover additional FY-1960 orders anticipated from the U. S. Marine Corps and the Military Assistance Program (MAP).[54]

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*Research, Development, Test, and Evaluation.

[51]Proj Sum, Status of HJ Imprv Prog, 12 Feb 60. HJ R&D Case Files, Box 13-563, RHA AMSC.

[52]ARGMA Semiannual Hist Sum, 1 Jan - 30 Jun 60, p. 127.

[53]HJ Prog Rept, Aug 60, p. 7.

[54]DF Cmt 2, CRD, DA, to OCO, 14 Apr 60, sub: Increase in LP Qty of XM-50 Rkts. (As cited in OTCM 37439, 26 May 60. RSIC.)

U
(~~S~~) Achievement of Program Objective, FY 1961-63 (U)

U
(~~S~~) The Improved Honest John Weapon System (XM-50 Rocket/M386 Launcher) finally reached the field in the last quarter of FY 1961; but the XM-50 rocket remained in the limited production category until the middle of FY 1963. In late February 1961, the ABMA established an Ordnance readiness date of July 1962 for the XM-50 Rocket/XM-33 Launcher combination, and a readiness date of November 1962 for the XM-50 Rocket/M289 Launcher combination.[55]

U
(~~S~~) The failure to meet the readiness date of January 1961 (Chart 2) for the XM-50/M386 combination was attributed to continuing motor problems which, in turn, caused an increase in FY-1961 funding requirements. At the end of August 1960, $250,000 in RDTE program authority had been received against an indicated annual level of $1.250 million, about $1 million of which was to be funded by the MAP.[56] In late October 1960, the ABMA announced that an additional $617,000 would be required to provide continuing support to the R&D test program. At the same time, it recommended to the OCO that the XM-50 Ordnance readiness date be extended from January to April 1961, because of difficulties experienced with performance of the rocket motor at high temperatures. Two months later, in mid-December 1960, the Agency received program authority for $117,000 to continue R&D testing through 15 January 1961, leaving a deficit of $500,000.[57] The revised commodity plan, as approved and published in December 1960, is shown in Chart 3.

(U) In February 1961, the OCO authorized the ABMA to use available program authority in continuing the XM-50 high temperature qualification

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[55] ABMA Semiannual Hist Sum, 1 Jan - 30 Jun 61 (6 vols.), I, 139; V, 173.

[56] HJ Prog Repts, Jul 60, pp. 9, 3-A; Aug 60, p. 7.

[57] HJ Prog Rept, Dec 60, pp. 2-3.

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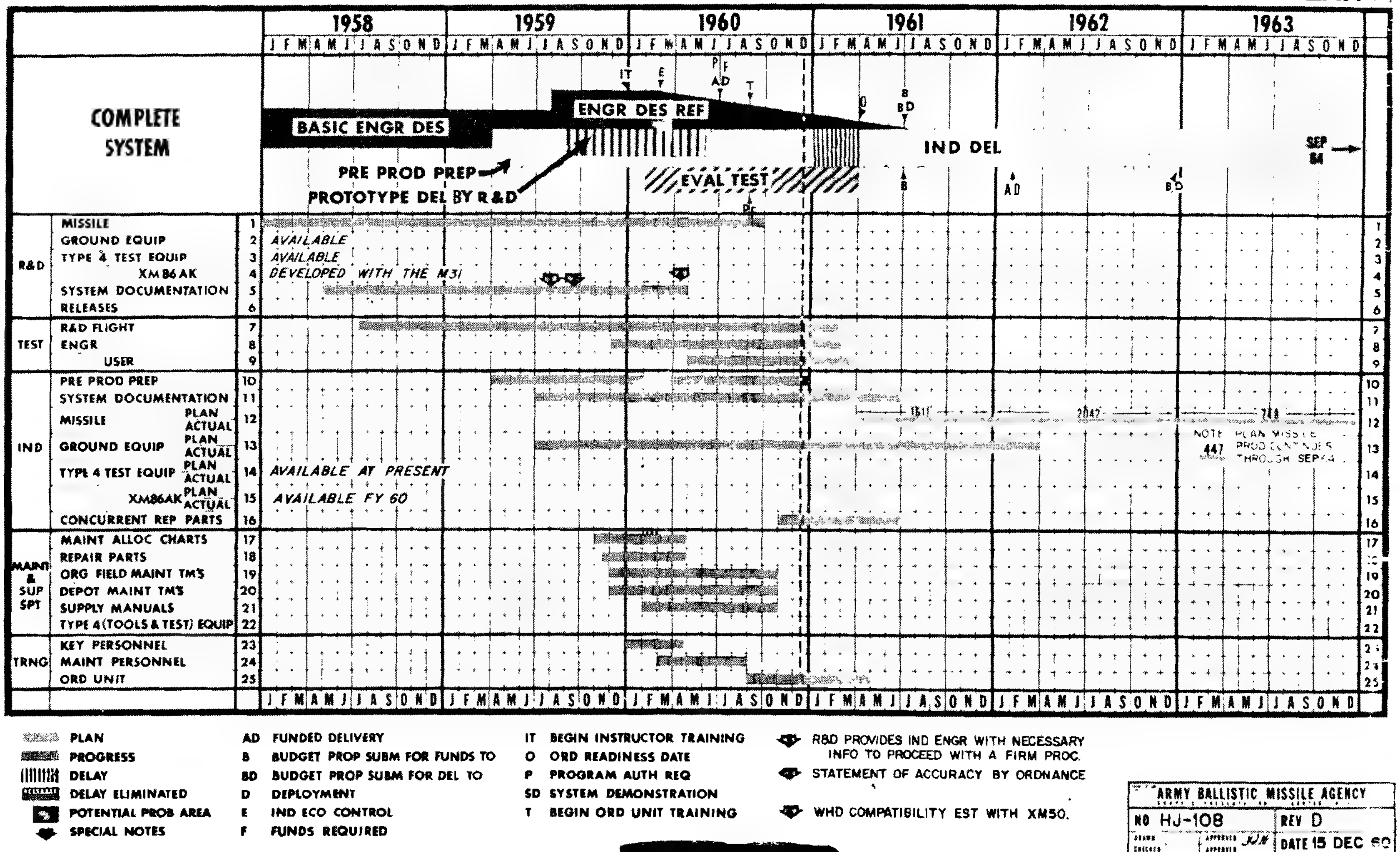
[redacted]

CHART 3

HONEST JOHN ROCKET 762mm XM50 COMMODITY PLAN (U)



[redacted]

UNCLASSIFIED

test program, and advised that additional program authority for $492,000 would be provided in March. The latter funds, received in mid-April 1961, increased the FY-1961 obligations to about $1.7 million and completed the RDTE funding for the Honest John Improvement Program.[58]

U (~~C~~) In the meantime, initial industrial deliveries of the XM-50 rocket, less warhead, fell about 30 days behind schedule because additional static tests were required to prove an acceptable loaded lot. The ABMA received two XM-31E3, FY-1960 pilot lot motors for acceptance testing in mid-May 1961; and by the end of that month, 126 motors had been delivered and accepted for field use.[59] The final weaponization plan for the XM-50 system is shown in Chart 4.

U (~~S~~) By separate actions in FY 1961, 1962, and 1963, the limited production category of the XM-50 rocket components was renewed and the authorized production quantities were increased to cover anticipated Army and MAP requirements. By the middle of FY 1963, the authorized limited production quantity of the XM-50 rocket, less warhead, had increased from 2,000 (FY-1960 buy) to 6,347.[60] In December 1962, the Secretary of the Army approved the reclassification of the improved Honest John rocket from limited production to standard A type. At the same time, the basic Honest John models M31A1C and M31A2 were reclassified from standard A to standard B type, and the M31 model was declared obsolete.[61]

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[58](1) HJ Prog Repts, Mar 61, p. 33; Apr 61, p. 15. (2) ABMA Chart No. HJ-109, Rev M, 18 Dec 61.

[59]HJ Prog Repts, Apr 61, p. 4; May 61, p. 4.

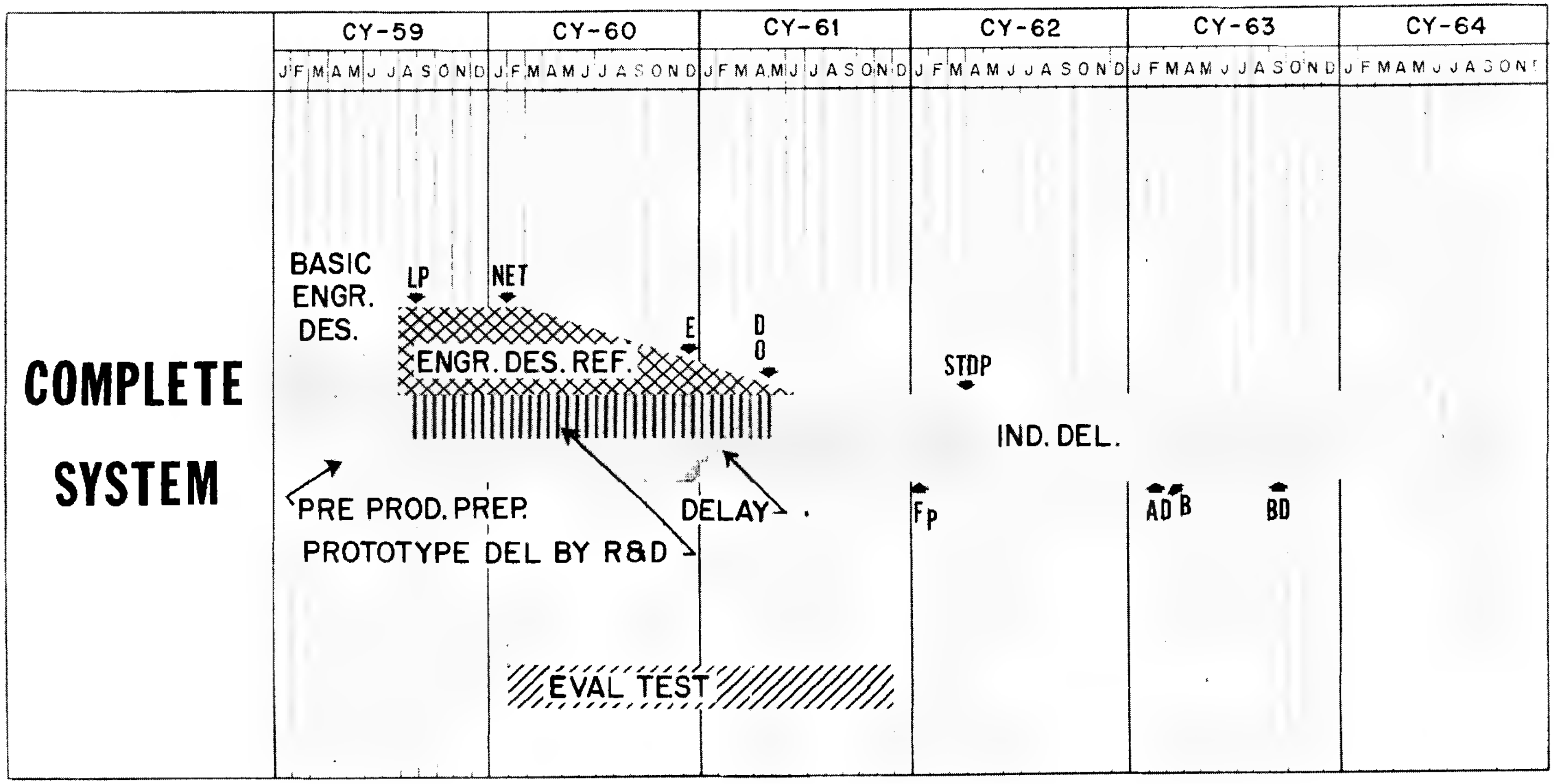
[60]OTCM's 37554, 29 Sep 60; 37743, 18 May 61; 37859, 21 Sep 61; 38125, 13 Aug 62. RSIC.

[61]AMCTCM 364, 13 Dec 62. HJ/LJ Cmdty Ofc File.

[redacted]

CHART 4

HONEST JOHN XM-50 SYSTEM WEAPONIZATION PLAN



AD FUNDED DELIVERY
D DEPLOYMENT
E INL ECO CONTROL
F FUNDS REQUIRED
O ORD READINESS DATE
NET NEW EQUIP TNG

B BUDGET PROP SUBM FOR FUNDS TO
BD BUDGET PROP SUBM FOR DEL TO
SD SYSTEM DEMONSTRATION
STDP STANDARD PROD
LP LIMITED PRODUCTION
P PROGRAM AUTH REQD

ABMA
NO. HJ-118 REV. I
DATE 15 SEP C!

[redacted]

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U
(~~C~~) Summary (U)

U
(~~C~~) As a result of the problems and delays enumerated above, the time and funds required to complete development of the improved Honest John rocket increased from the original estimate of 24 months and $3.545 million, to some 72 months and $19 million.[62] All told, the Department of the Army invested some $39.2 million in RDTE effort on the basic and improved Honest John systems during the 1951-61 period.[63] But despite the study rise in costs over this 10-year period, the price paid for development of the Honest John was remarkably low when compared with present-day cost trends. An excellent example is the Lance surface-to-surface missile which is currently being developed to replace the Honest John and Lacrosse systems. The U. S. Army Missile Command let the R&D contract for the Lance early in November 1962, shortly before standardization of the improved Honest John. Just 19 months later, at the end FY 1964, obligations against the RDTE funding already totaled $69.3 million with actual expenditures of some $52.8 million.[64]

U
(~~C~~) Contractual Structure and Related Problems (U)

(~~U~~) With one major exception, the same development concept was applied in the prosecution of the Honest John Improvement Program as in the basic program. The development schedules for both rocket systems were based on telescoped programming; that is, the feasibility studies, design and development, engineer and service evaluation, and production

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[62] The annual funding levels for the XM-50 program (in millions of dollars) were: FY 1956 - 1.113; FY 1957 - 2.165; FY 1958 - 2.455; FY 1959 - 6.838; FY 1960 - 4.737; FY 1961 - 1.700. (1) Proj Sum, Status of HJ Imprv Prog, 12 Feb 60. HJ R&D Case Files, Box 13-563, RHA AMSC. (2) HJ Prog Rept, Aug 60, p. 7. (3) ABMA Chart No. HJ-109, Rev M, 18 Dec 61.

[63] Ibid.

[64] Lance Project Management Master Plan, 30 Jun 64, pp. 1-4, 25.

engineering phases were overlapped to expedite field delivery of the end item.[65] The main difference in the make-up of the two programs lay in the contractual concept.

(U) In the M31 program, the Douglas Aircraft Company served as the prime contractor, with complete responsibility for design and development of the rocket and for furnishing detailed drawings and specifications for use by Government agencies and contractors participating in the program. The company also participated in the Honest John Improvement Program, but the scope of its responsibility was reduced to that of a subcontractor. The Ordnance Missile Laboratories of the Redstone Arsenal (later the ARGMA) served as the prime contractor equivalent, with responsibility for furnishing technical requirements, drawings, and specifications, and for exercising technical supervision and control of the overall project.

(U) To facilitate an orderly and rapid transition from R&D production to industrial production, the contractors used for the M31 rocket production were selected for the XM-50 rocket development, and the same contractor facilities served as the initial source of production for tactical units.[66] Major Government agencies and contractors participating in the program are shown in Charts 5 and 6.

U
(~~C~~) Proprietary Rights Dispute with Douglas Aircraft (U)

(U) The Redstone Arsenal and the Los Angeles Ordnance District began contract negotiations with the Douglas Aircraft Company in January 1955, several months before the Chief of Ordnance approved the initial

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[65] The telescoped program for the improved Honest John is illustrated in Charts 1 thru 4, pp. 81, 83, 86, 88.

[66] (1) HJ Msl Sys Plan, ARGMA MSP-11, 1 Jun 60, pp. 1-C, 5-D, 27-E. (2) Ltr, 00/5C-7814, CofOrd to CG, RSA, 8 Apr 55, sub: HJ Imprv Prog - RSA Rept 3M51P dated 11 Mar 55. ORDTU File, Jan - Jun 55, FRC.

CHART 5—R&D Contract Structure - Honest John Improvement Program

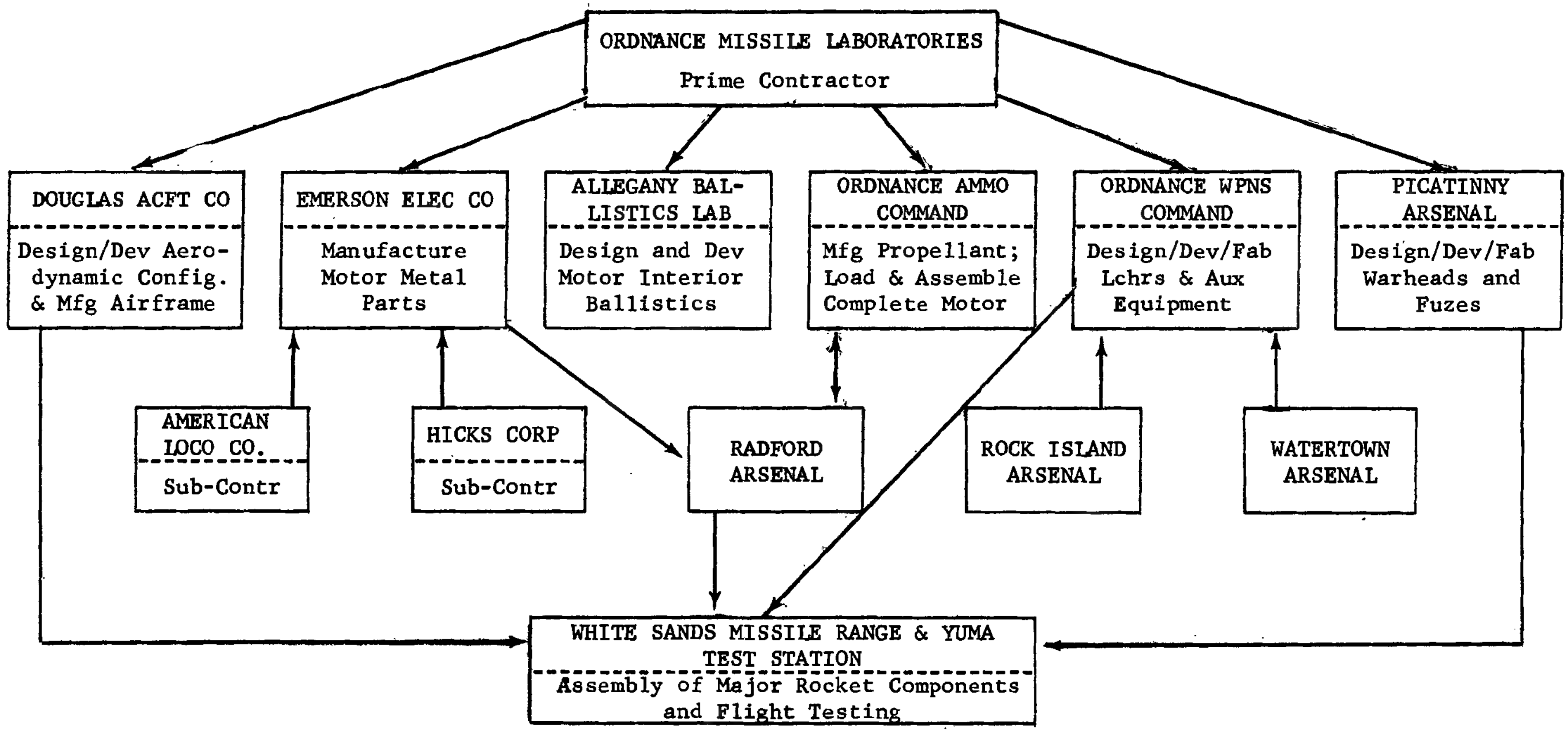
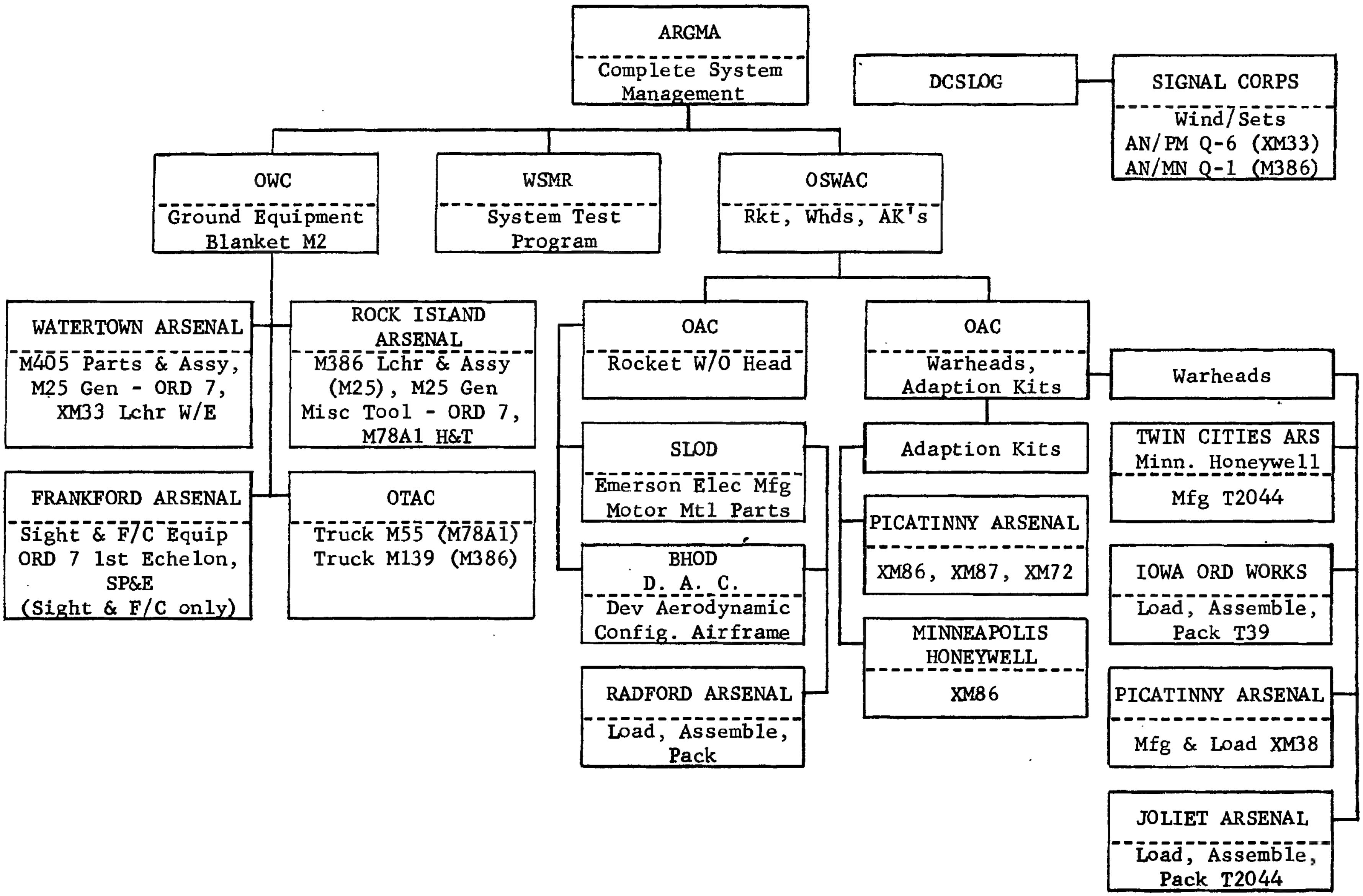


CHART 6—Industrial Contract Structure - Honest John Improvement Program



development plan.[67] To expedite action on the program (then scheduled for completion by 1 April 1957), the Arsenal authorized Douglas to initiate the Phase I research studies under Item 13 of its basic contract (ORD-22), and solicited firm proposals for a new R&D contract covering the revised scope of work. The contractor's cost proposal, received in late January 1955, touched off a heated dispute over proprietary rights, and negotiations were deadlock until early May 1955.[68]

U (~~FOUO~~) This was not the first such dispute with the Douglas Aircraft Company. It will be recalled that in March 1952 the company had threatened to pull out of the basic Honest John program unless it was awarded both the production engineering study and initial production contracts. Rather than risk an 18-month delay in the R&D program, the Chief of Ordnance gave Douglas both contracts, but emphasized that future procurement would be handled on an open competitive basis. Nevertheless, Douglas Aircraft continued to agitate for the first volume production contract, and again succeeded in temporarily stalling procurement actions in FY 1954 by imposing an ill-conceived legal restriction on all Honest John drawings to prevent their duplication and release to other contractors. The Ordnance Corps' legal staff took the position that the provisions of the contract with Douglas granted to the Government full right and title to, and interest in, the drawings produced and delivered thereunder, and that the drawings marked with the restrictive legend could not be accepted as complying with the contract terms. Accordingly, the Contracting Officer nullified the restrictive legend on those Ordnance drawings already delivered, and ordered the Douglas Aircraft Company to

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[67] For details relating to the original plan and subsequent changes thereto, see above, pp. 66 ff.

[68] (1) Ltr, LAOD to CG, RSA, 11 Feb 55, sub: Engr R&D Prog, HJ Rkt. ORDTU File, Jan - Apr 55, FRC. (2) Ltr, CG, RSA, to CofOrd, 3 May 55, sub: Ord Proj TU2-1029, HJ Imprv Prog. ORDTU File, May - Aug 55, FRC.

cease such practice in the future or suffer the consequences.[69] This action settled the proprietary rights dispute of 1954, but it led to another in 1955.

U (~~FOUO~~) As noted earlier, the Douglas Aircraft Company initiated the fin-spin research studies in early January 1955, under a change order to Item 13 of Contract ORD-22. This order was essentially a letter-order type agreement used to cover the initial research effort until a new R&D contract could be finalized. It was based on the initial cost proposal, submitted by Douglas in September 1954, which quoted a total estimated cost of $212,000, including a basic engineering R&D cost of $200,000 plus a 6 percent fixed fee of $12,000.[70] Since the firm proposal solicited for negotiation of the new R&D contract was to cover essentially the same scope of work, the Redstone Arsenal expected no appreciable price increase over that originally quoted. Yet that is precisely what happened.

U (~~FOUO~~) In its cost proposal, submitted on 27 January 1955, Douglas left the basic R&D cost unchanged, but increased the fixed fee from 6 percent ($12,000) to 12 percent ($24,000), for an aggregate contract price of $224,000 for the 18-month program. The cost breakdown covering the first task assignment (fin-spin study program) quoted a total estimated cost of $16,574 ($14,798 plus a 12 percent fixed fee of $1,776).[71] Douglas' Director of Contracts later explained that the profit rate had been increased to 12 percent as a condition for accepting the proposed technical data requirement clause. "If we are directed to accept this

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[69] See Cagle, History of the Basic (M31) Honest John Rocket System, 1950 - 1964, pp. 54-56, 59-60, 132-35.

[70] (1) Ltr, A-241-4192, DAC to LAOD, 21 Sep 54, cited in Ltr, A-241-683, same to same, 27 Jan 55, sub: Engr R&D Prog, HJ Rkt. (2) Ltr, LAOD to CG, RSA, 11 Feb 55, sub: same. Both in ORDTU File, Jan - Apr 55, FRC.

[71] Ltr, A-241-683, DAC to LAOD, 27 Jan 55, sub: Engr R&D Prog, HJ Rkt. ORDTU File, Jan - Apr 55, FRC.

Technical Data Requirement," he argued, "it is reasonable under the circumstances that we receive a Fixed Fee commensurate with the 'Proprietary Rights' gained by the Federal Government. . . ."[72] In this connection, the District Chief of the LAOD reported:

. . . Contractor has stated verbally that it now expects the same increased fee for all new R&D work regardless of whether the Technical Data Requirement clause or the standard ASPR 9-107.1 clause is used. . . . Contractor states that under . . . [the Ordnance Corps' interpretation of the standard clause] it should have been getting 15% fee under previous and existing R&D procurement, and would not, in fact, have accepted the usual 6% fee if it had knowingly been granting such reproduction rights.[73]

U ~~(FOUO)~~ The Redstone Arsenal had inserted the technical data requirement clause in the proposed provisions of the engineering R&D contract to clarify and define the standard proprietary rights article used in existing contracts, and thereby avoid recurrence of past difficulties. This specific clause, however, was not intended as a mandatory condition of the overall contract. On the contrary, it stated that if Douglas Aircraft should assert proprietary rights for specific information or items, a modified technical data clause, giving the Government only limited rights to such data, might be negotiated. For all other items of a non-proprietary nature, the broad terms of the proposed technical data clause would be applicable. With this view, the Arsenal had requested the LAOD to obtain from Douglas detailed information as to any specific proprietary information or items that might be involved.[74]

U ~~(FOUO)~~ Instead of providing the proprietary rights data necessary for the negotiation of a modified technical data clause, Douglas Aircraft

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[72]Ltr, G-24-259, DAC to LAOD, 4 Feb 55, sub: same. File same.

[73]Ltr, LAOD to CG, RSA, 11 Feb 55, sub: same. File same. (ASPR: Armed Services Procurement Regulation.)

[74]1st Ind, CG, RSA, to LAOD, 16 Oct 54, on Ltr, LAOD to CG, RSA, 28 Sep 54, sub: Contr DA-04-495-ORD-22, DAC Engr R&D Prog, HJ; as cited and discussed in Ltr, CG, RSA, to LAOD, 28 Feb 55, sub: Engr R&D Prog, HJ Rkt. ORDTU File, Jan - Apr 55, FRC.

[redacted]

simply added a 6 percent fee for "rights" under information or items which were not defined even in general terms. Without knowing what specific items or information might be involved, the Arsenal could not determine whether it desired such rights or items at the proposed fee, or whether such items or all specific proprietary items should be eliminated from the broad scope of the technical data clause and otherwise provided for at a lesser fee.[75]

[redacted] The Chief of Ordnance advised the Arsenal on 8 March 1955 that he had "no intention of approving a 12% fee" on the basis of facts then available, adding that such "approval would constitute a dangerous precedent, not only as regards DAC but in relations with other contractors as well." He directed that the LAOD attempt to determine the "exact reasons" which prompted Douglas to demand such a fee, and that the Redstone Arsenal "make an early determination as to whether the work could be done elsewhere in the event that negotiations with DAC break down." Meanwhile, the LAOD was to proceed with negotiations of the supplement for the fin-spin study "until an impass (sic) is reached."[76]

[redacted] Subsequent negotiations between the Chief, LAOD, and Mr. F. W. Conant, Senior Vice President of Douglas Aircraft,[77] failed to produce an acceptable solution to the problem. With reference to the Arsenal's request for a detailed listing of proprietary items, the District Chief reported, on 16 March, that the contractor "claims inability to list existing or possible future discoveries which might be incorporated in the end item." This position, he continued, "is reasonable and not merely an attempt to avoid supporting his claim to proprietary

[75] Ltr, CG, RSA, to LAOD, 28 Feb 55, sub: same. File same.

[76] Ltr, 00/5C-5485, CofOrd to CG, RSA, 8 Mar 55, sub: Contr No. DA-04-495-ORD-22, Amdt No. 24. ORDTU File, Jan - Apr 55, FRC.

[77] It was Mr. Conant who started the feud over proprietary rights in March 1952. See above, p. 93.

rights."[78] The LAOD report further revealed that the contractor's demand for the increased (12%) fee was largely predicated on the outcome of the proprietary rights dispute in 1954.[79] It summed up the contractor's position in these words:

> . . . It is an oversimplification of the issue to feel that the contractor is willing to "sell" proprietary rights for the amount of the increase in fee. Douglas . . . has heretofore accepted R&D contracts at 6% and 7% fees under the concept (based to a large extent on his interpretation of existing Patent Rights Articles) that production-type contracts would be received for items developed by the company. Contractor is now fully aware of the Ordnance interpretation of the Patent Rights Articles and, in the absence of any assurance that he will receive the initial production contract, feels he should establish a new concept in soliciting R&D activities. This concept, broadly stated, is that engineering work should carry a higher fee than production work. . . .[80]

At the same time, the Redstone Arsenal sent the Chief of Ordnance a proposed plan for the Honest John Improvement Program, along with the following comment:

> . . . [The] recommended program could be conducted without the aid of Douglas Aircraft Company, Incorporated, provided an early settlement of the "Proprietary Rights" question cannot be made. However, Douglas Aircraft Company's contribution to the R&D program make (sic) it most desirable that they participate in the improvement program.[81]

([redacted]) Meanwhile, the Legal Division, OCO, made an exhaustive investigation of the entire question of proprietary rights and technical data requirements as applied to Ordnance Corps R&D contracts. Pending the receipt of definitive guidance from the Department of Defense (DOD), the General Counsel, in late March, established an interim procedure

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[78] 1st Ind, LAOD to CG, RSA, 16 Mar 55, on Ltr, CG, RSA, to LAOD, 28 Feb 55, sub: Engr R&D Prog, HJ Rkt. ORDTU File, Jan - Apr 55, FRC.

[79] Namely, the enforcement of the Ordnance Corps' interpretation of the standard patent rights article. See above, pp. 93-94.

[80] 1st Ind, LAOD to CG, RSA, 16 Mar 55, on Ltr cited in footnote78.

[81] Ltr, CG, RSA, to CofOrd, 16 Mar 55, sub: Ord Proj TU2-1029, HJ Imprv Prog. ORDTU File, Jan - Apr 55, FRC.

governing the business transactions then underway with Douglas, including the contract negotiations relating to the Honest John Improvement Program.[82] In late March, the Redstone Arsenal received a priority message directing that the Ordnance District enter negotiations with Douglas strictly on the basis of guidance outlined in the procedure. Specifically, the contract was to include a proprietary rights clause that would be "acceptable to OCO," and the fixed fee was not to exceed the 6-percent rate authorized in the basic contract (ORD-22). For any fee increase beyond 6 percent, the LAOD was to provide complete justification, keeping in mind that increased engineering costs, if justified, would normally be reflected in cost of the contract rather than in the fee.[83]

(U) In early May 1955, the Douglas Aircraft Company agreed to resume contract negotiations on the basis of a standard profit rate of 6 percent and an appropriately modified proprietary rights clause that would protect the interests of both parties.[84] Representatives of the company, the OCO, the LAOD, and the Redstone Arsenal worked out the terms of the agreement and the scope of work during a meeting held at the contractor's plant on 25 May.[85] The work to be covered in the R&D contract consisted essentially of five phases, as follows.[86]

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[82] Ltr, CofOrd to CG, RSA, 25 Mar 55, sub: Negotiations with DAC, and Incl thereto. ORDTU File, Jan - Apr 55, FRC.

[83] TT ARL 769, CofOrd to CG, RSA, 30 Mar 55. File same.

[84] Ltr, CG, RSA, to CofOrd, 3 May 55, sub: Ord Proj TU2-1029, HJ Imprv Prog. ORDTU File, May - Aug 55, FRC.

[85] It was during this meeting that the OCO representative announced a cut-back in the improvement program (i.e., cancellation of work on the improved motor) to bring the total effort within limits of available funds. See above, p. 69.

[86] Ltr, CG, RSA, to LAOD, 7 Jun 55, sub: Ord Proj TU2-1029, HJ Imprv Prog. ORDTU File, May - Aug 55, FRC.

I. Research - Modification, assembly, and flight test of 26 M31A1 rockets to establish dispersion characteristics.

II. Development of an improved spin rocket system.

III. Modification and flight test of modified Type II (M31A1) rockets.

IV. Development and flight test of short-range (Demijohn) system.

V. Observation only of 18 engineering tests to be conducted by the White Sands Proving Ground.

(U) Near the end of June 1955, the LAOD awarded Douglas Aircraft two new cost-plus-fixed-fee (CPFF) contracts. One of these (ORD-693) was an R&D contract covering Phase I of the improvement program; the other (ORD-673) was a task order type of agreement that replaced Item 13 of Contract ORD-22. The latter contract, which had been in effect since October 1950, was terminated upon completion of programmed work in mid-1957.[87]

(U) Task Order Contract (ORD-673)

(U) Contract ORD-673, signed on 28 June 1955, consisted of individual task orders for specific materials and/or services relating to the Honest John rocket. Each preliminary request and resultant task order was written on a "best efforts" basis. The preliminary request outlined the technical requirements and phased schedules for work to be performed; provided for the direction and/or redirection of contractor's effort by a designated project officer; and specified the maximum amount of money that could be spent. Within 30 days from the date of the request, the contractor was required to submit a written proposal setting forth separately for each phase a detailed cost breakdown and applicable fixed fee. The Ordnance District then issued a formal Task Order which specified the work schedule, the total estimated cost, the

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[87](1) Notes on Status of DAC Contracts. ORDTU File, Sep - Dec 56, FRC. (2) MFR, John A. Robins, 10 Jun 57 [RE DAC Contract ORD-673]. HJ R&D Case Files, Box 13-562, RHA AMSC.

amount of the fixed fee to be paid upon satisfactory completion of the task, and any necessary adjustment in funds obligated under the contract.

(U) For example, $25,000 was obligated under Preliminary Request No. 7 for certain work relating to development of the T2037 practice warhead. The finalized amount of Task Order No. 7, issued on 19 October 1956, was $17,308 (including a fixed fee of $980), resulting in the deobligation of $7,692. Other materials and/or services provided under the respective task orders included participation in qualification tests of the XM-386 launcher; fabrication of ballast assemblies for the T2037 practice head; design, development, and fabrication of nose structures for the XM-86 adaption kit; a preliminary design study to establish the basic configuration of the XM-50 rocket; over-acceleration tests of the new XM-31E1 motor; design of a nose and pedestal structure to be compatible with the XM-31E1 motor; fabrication of airframe components and fins for the XM-50 rocket; and various non-flight studies relating to other phases of the improvement program.[88] The Douglas Aircraft Company completed deliveries under the contract in April 1961, and final settlement was made in March 1962. The total value of the contract, through close-out, was $898,911.[89]

(U) R&D Contract (ORD-693) (U)

(U) The basic R&D contract (ORD-693), covering the research phase of the improvement program, was awarded by the LAOD on 29 June 1955. A supplemental agreement, signed later in 1955, increased the scope of work to include all other phases of the planned program except that relating to the Demijohn (Phase IV).[90] With the addition of Phases II,

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[88]Modifications to Contr DA-04-495-ORD-673, 28 Jun 55. HJ R&D Case Files, Box 13-562, RHA AMSC.

[89]Closed Out Contract Listings, MICOM, 1 Jul 64, p. 15.

[90]This phase was dropped from the program plan in August 1955. See above, pp. 70-71.

III, and V, the obligated amount of the contract was as follows:[91]

Phase	Estimated Cost	6% Fixed Fee	Total
I.	$ 230,777	$ 13,847	$ 244,624
II.	95,913	5,755	101,668
III.	378,216	22,693	400,909
V.	15,704	942	16,646
Total:	$ 720,610	$ 43,237	$ 763,847

(~~C~~ U) Because of funding problems, work on the new motor had been cancelled and effort under the Douglas contract had been oriented toward design of the XM-31E2 rocket using the standard M6 motor and an improved fin-spin system. Early in 1956, the rocket development effort was suspended pending a final decision on reinstatement of the motor program. Upon approval of the extended level of effort, in May 1956, the Redstone Arsenal resumed development of the new motor and reoriented the program accordingly.[92]

(~~C~~ U) Since the rocket design established during the initial studies had been based on performance characteristics of the standard M6 motor, a supplementary Phase I study was necessary to establish the design parameters of the improved (XM-50) rocket. In June 1956, the Arsenal instructed the LAOD to arrange for performance of the supplementary study under the task order contract[93] and to revise the scope of work in the second and succeeding phases of the R&D contract. Upon completion of the supplementary study, the contractor was to proceed with Phase II of the revised R&D contract and continue through the final development

[91](1) Ltr, LAOD to CofOrd, 13 Sep 55, sub: Req for Appr of Suppl Agrmt to DAC Contr DA-04-495-ORD-693. (2) Ltr, CG, RSA, to CofOrd, 8 Nov 55, sub: Ord Proj TU2-1029, HJ Imprv Prog. Both in ORDTU File, Sep - Dec 55, FRC. (3) Also see copy of Contr ORD-693 in HJ R&D Case Files, Box 13-562, RHA AMSC.

[92]See above, pp. 73-75.

[93]The LAOD obligated $50,000 for this study under Preliminary Request #9. The final amount of the task order, issued on 2 January 1957, was $27,913 ($26,333 plus a fixed fee of $1,580), decreasing the original obligation by $22,087. Mod #14, Task Order #9, Contr ORD-673. HJ R&D Case Files, Box 13-562, RHA AMSC.

tests which were to be completed by mid-1958.[94]

(U) The supplemental agreement to the R&D contract, signed on 18 July 1956, realigned the scope of work beyond Phase I, with no change in monetary value. Under terms of the agreement, the contractor's obligation to perform to completion would be subject to the "extent of the available balance of the present allotted amount," i.e., $763,847. The final cost and fixed fee, as well as the final delivery schedule, were to be negotiated in accordance with provisions of the basic contract.[95]

(U) As a result of technical difficulties later encountered, the final obligated amount of the contract more than doubled the initial allotment. Douglas completed deliveries under the contract in December 1959, and final settlement was made 3 years later. The value of the contract at close-out was $1,731,338.[96]

(U) <u>Other R&D Contracts</u>

(U) Other Ordnance Corps contracts for the final design and development of the XM-50 rocket (less warhead) amounted to $6,539,289. The Emerson Electric Manufacturing Company had two R&D contracts totaling $4,437,636; Douglas Aircraft had three contracts (in addition to ORD-673 and ORD-693) amounting to $2,101,653.[97] The Allegany Ballistics Laboratory developed the motor interior ballistics under a contract with the Navy's Bureau of Ordnance. Other components for the improved system were developed by Government agencies (see Chart 5 above).

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[94] Ltr, CG, RSA, to LAOD, 15 Jun 56, sub: HJ Imprv Prog, Ord Proj TU2-1029. ORDTU File, May - Aug 56, FRC.

[95] Mod No. 2 to DAC Contr DA-04-495-ORD-693, 18 Jul 56. HJ R&D Case Files, Box 13-562, RHA AMSC.

[96] Closed Out Contract Listings, MICOM, 1 Jul 64, p. 16.

[97] <u>See</u> Contract List, Appendix B.

CHAPTER IV

U (~~S~~) EVOLUTION OF THE XM-50 ROCKET (U)

[redacted] This chapter traces the technical developments leading to the final tactical design of the improved Honest John rocket. The Army General Staff authorized the initiation of an accuracy improvement program in November 1954, following a presentation on the performance limitations of the M31 system then in the field. Because of the high defense priority accorded this program and the existing shortage of R&D funds, the Ordnance Corps' proposal for development of an advanced omni-range rocket known as the Honest John Senior was dropped from active consideration.[1]

U (~~S~~) Military Requirements (U)

U (~~S~~) There were no formal military characteristics published for the Honest John Improvement Program. The general guidelines, however, specified a requirement for a free-flight rocket capable of carrying atomic and non-atomic warheads to a maximum effective range of about 29,000 meters and a minimum range of no more than 6,000 meters. Specific requirements called for a 15 percent increase in the 25,000-meter range of the M31 rocket without exceeding the weight of the rocket (5,900 pounds), and improvement in system delivery accuracy to the maximum extent possible within the funding limitations of the program.[2]

U (~~S~~) Preliminary Evaluation of the Problem (U)

U (~~S~~) The original plans for achieving the desired improvements were

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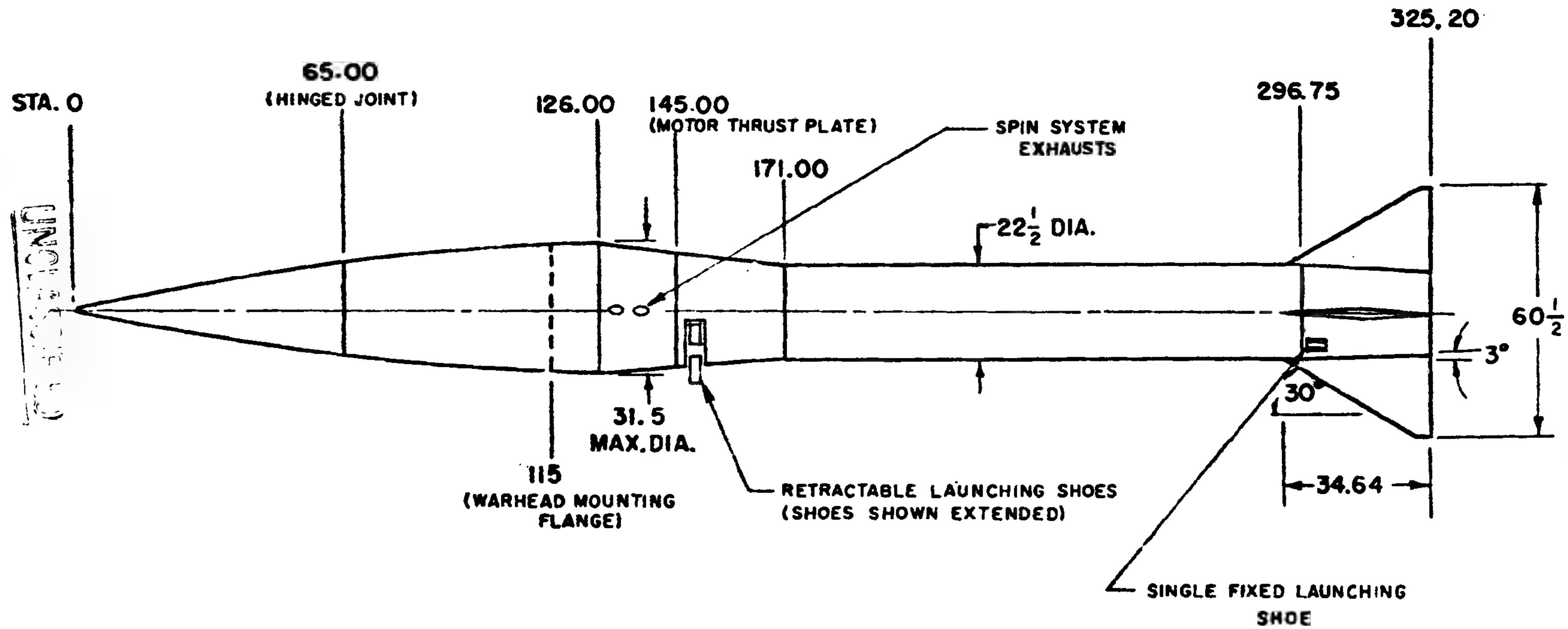
[1] *See* above, pp. 52-64.

[2] (1) OTCM 37178, 17 Sep 59. RSIC. (2) HJ Msl Sys Plan, ARGMA MSP-11, 1 Jun 60, pp. 1B, 2B.

MODEL 1866 – HONEST JOHN B

RECOMMENDED CONFIGURATION



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based on preliminary studies and proposals by the Redstone Arsenal and the Douglas Aircraft Company. Both of the proposals provided for essentially the same improvements, the main difference being in the number of flight test rounds required. They placed primary emphasis on improvements in system accuracy, but also gave important consideration to certain proven design changes aimed at improving the effective range and logistic capabilities. Specifically, they called for the development of a completely new weapon system having improved accuracy, increased effective range, extended temperature limits, and improved operational capabilities.[3]

(U) Using the Senior John study as a point of departure, Douglas Aircraft concluded that an improved Honest John "B" (Model 1866) could be developed that would compare with the standard M31 rocket (Model 1236F) as follows:

	Model 1866	Model 1236F
Rocket Gross Weight[a]......	4,890 lbs.	5,900 lbs.
Maximum Range[a]............	37,000 yds.	27,500 yds.
Accuracy (Time Fuze, CPE).	280 yds.[b]	440 yds.[c]
Gross Length..............	325.5 in.	327 in.
Gross Fin Span............	60.5 in.	104 in.
Launcher Gross Weight.....	6,000 lbs.	45,150 lbs.

NOTES: [a]With 1,500-pound warhead.
[b]At 30,000 yards.
[c]At 27,500 yards.

The tentatively recommended configuration (see sketch) was based on theoretical estimates of accuracy improvement levels expected from the proposed research tests. The final system design, of course, would be based upon consideration of actual research test results, development time and costs, and the latest tactical requirements.[4]

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[3](1) Ltr, CG, RSA, to CofOrd, 13 Dec 54, sub: Ord Proj TU2-1029, Imprv Prog for HJ Sys. ORDTU File, Sep - Dec 54, FRC. (2) DAC Rept No. SM-18695, 7 Jan 55, sub: Honest John "B" (DAC Model 1866) - A Preliminary Evaluation of an Honest John System Improvement Program, p. 1. RSIC. (3) Also see above, pp. 66-68.

[4]DAC Rept SM-18695, 7 Jan 55, pp. 1, 5, 7.

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(~~C~~) Initial Design Study - XM-31E2 Rocket (U)

(U) The research phase of the program began early in 1955 as a major product improvement to the standard Honest John rocket. To achieve the desired accuracy improvements, the Redstone Arsenal and the Douglas Aircraft Company had recommended the development of a completely new rocket with an improved fin-spin system and a new rocket motor. However, because of funding limitations, development of the new motor was dropped and the reduced level of effort was directed toward an improved version of the standard rocket, known as the XM-31E2.[5]

U (~~C~~) The technical approach thus adopted for the initial design study was predicated on the design of an improved fin-spin system to reduce rocket stability to an optimum level, thereby decreasing the azimuth probable error. Available flight test data indicated that the M31 rocket was over-stable and therefore susceptible to low level wind gust effects and to errors in surface wind assessment. To eliminate these sources of error, factors relating to the spin or aerodynamic roll of the rocket and to the size and configuration of the fins were studied together in the initial research phase.

U (~~C~~) The primary objectives of the program were to determine more accurately the magnitude of major sources of error in the M31 rocket, and to obtain the data necessary for the desired improvements. The R&D contract (ORD-693) called for a 1-week wind tunnel test to determine the fin size required, and the fabrication of necessary parts for 2 yaw oscillation tests and 24 variable stability tests using standard and modified M31A1 rockets.[6]

U (~~C~~) The research test firings began at the White Sands Proving

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[5] See above, pp. 65-73.

[6] (1) OTCM 37143, 6 Aug 59. RSIC. (2) Contr ORD-693, 29 Jun 55. HJ R&D Case Files, Box 13-562, RHA AMSC. (3) Ltr, CG, RSA, to LAOD, 7 Jun 55, sub: Ord Proj TU2-1029, HJ Imprv Prog. ORDTU File, May - Aug 55, FRC.

[redacted]

Ground (WSPG) in late May 1955 and continued through mid-February 1956, a delay of about 6 months beyond the original target completion date of August 1955.[7] The first eight firings, completed in July 1955, were standard-fin variable stability tests, the aim of which was to determine the magnitude of thrust malalignment and the actual yaw oscillation distance of the M31 rocket. These were followed, in August and September, by two yaw oscillation tests and eight stability tests of modified M31 rounds with 16-inch clipped fins. With the firing of the 18th round on 30 September 1955, the tests were temporarily suspended.[8]

(U) A preliminary study of data collected in the first 16 stability tests indicated that the 8 rounds with standard fins had a thrust malalignment error of 8.8 mils. The other 8 rounds with 16-inch clipped fins had an indicated error of 9.6 mils instead of the predicted 20 mils; however, a 22-mil shift in the center of impact of these rounds made the validity of the data questionable. Because of the partial loss of instrumentation during the second yaw oscillation test, no definite conclusion could be made. Nevertheless, an analysis of available test data indicated that the clipped fins, together with a spin bucking system, would probably provide the desired improvement in lateral dispersion. But before firm design parameters could be established, it would be necessary to test a third 16-inch yaw oscillation round and complete the eight remaining variable stability tests. The Chief of Ordnance approved this approach in late December 1955.[9]

(U) Meanwhile, Douglas Aircraft resumed the test firings at the

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[7](1) Ibid. (2) Msg, CG, RSA, to CofOrd, 11 Jun 55. ORDTU File, May - Aug 55, FRC. (3) Msg, CG, WSPG, to CofOrd, 15 Feb 56. ORDTU File, Jan - Apr 56, FRC.

[8](1) TT's, CG, WSPG, to CofOrd, 6 Jun, 23 Jun, 14 Jul, 4 Aug, 5 Aug, 9 Aug, 2 Sep, & 4 Oct 55. ORDTU Files, May - Aug 55 & Sep - Dec 55, FRC. (2) Ltr, CG, RSA, to CofOrd, 12 Dec 55, sub: Ord Proj TU2-1029, Proj Status. ORDTU File, Sep - Dec 55, FRC.

[9](1) Ibid. (2) Ltr, 00/5C-27840, CofOrd to CG, RSA, 22 Dec 55, sub: Proj TU2-1029, HJ. ORDTU File, Sep - Dec 55, FRC.

[redacted]

WSPG in mid-December 1955. Two variable stability rounds were fired on 16 December and two on 20 January 1956, followed by the third yaw oscillation test on 27 January and the last four stability tests on 13 February 1956.[10] The results of these tests confirmed the earlier prediction that an improved fin-spin design would eliminate the major sources of lateral or deflection error, but any significant improvement in range accuracy would require an entirely new rocket motor design. In view of the decision then pending on possible reinstatement of the motor program, work on Phase II of the XM-31E2 program was suspended in February 1956 and remained so for the next 3 months.[11]

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(~~C~~) Supplementary Design Study - XM-50 Rocket (U)

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(~~C~~) In June 1956, shortly after reinstatement of the motor program, Douglas Aircraft undertook a supplementary Phase I study to establish a basic configuration for the new Honest John rocket.[12] The primary objective of this preliminary design study was to achieve increased accuracy and tactical suitability of the overall rocket system by the incorporation of a new motor propellant, a redesigned motor case, an improved spin system, and a new aerodynamic design for improved stability. The criteria of improvement specified by the Ordnance Corps were increased accuracy and effective range, reduced weight, and improved operational capabilities. Also specified were certain design characteristics; namely, the use of ARP (instead of OIO) propellant; retention of the existing motor outside diameter of 22 7/8 inches; use of non-critical steel for the motor case, without heat treatment; use of a modified Type III compartment head (station 0 to 115); provision for the use of

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[10](1) TT's, CG, WSPG, to CofOrd, 19 Dec 55, 23 Jan 56, 31 Jan 56, & 15 Feb 56. ORDTU Files, Sep - Dec 55 & Jan - Apr 56, FRC. (2) Also see Table I, Appendix A.

[11]See above, pp. 73-75.

[12]See above, p. 101.

standard launching equipment with minimum changes to handling gear; and minimum cost producibility compatible with accuracy.[13]

(U) The supplemental Phase I study, completed in August 1956, resulted in a proposed rocket design initially known as Model DM-8D and later designated the XM-50. The proposed model was considerably smaller and lighter than the standard M31 rocket. The rocket gross weight was reduced 18 percent (to about 4,780 pounds with a 1,500-pound payload), the overall length about 9 percent (from 327 to 297 inches), and the gross fin span 47 percent (from 104 to 55 inches). Preliminary estimates indicated that these reductions in weight and major dimensions, together with the new hardware design features, would improve the rocket's tactical suitability and provide a 15 percent increase in maximum useable range (from 27,300 to 31,400 yards), as well as a significant improvement in ballistic accuracy. Assuming the achievement of all contemplated component improvements and the maintenance of adequate quality control over the final product, the deflection and altitude accuracy of the tactical system (for time fuzing) would be improved about 50 percent and the range accuracy about 30 percent.[14]

(U) The maximum range capability for the DM-8D rocket with 1,500-pound and 1,170-pound payloads was estimated at 34,000 yards and 35,000 yards, respectively, an increase of about 24 percent over the maximum range capability of the M31 rocket. In establishing the total impulse necessary to achieve a maximum useable range of 31,400 yards (about 90 percent of the maximum range capability), the design engineers considered such factors as the payload to be delivered, non-motor structure weight, motor performance characteristics, and drag characteristics of the rocket. An analysis of these factors indicated the requirement for

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[13] Ltr, LAOD to DAC, 2[illegible] Jun 56, as cited and summarized in DAC Rept No. SM-27103, 10 Aug 56, sub: Preliminary Design Study of an Improved Honest John Rocket, Model DM-8D, pp. 1-2, 32. RSIC.

[14] DAC Rept No. SM-27103, 10 Aug 56, sub: Prelim Design Study of an Imprv HJ Rkt, Model DM-8D, pp. i-ii, 1-2, 35-37. RSIC.

a total impulse of about 360,000 pound-seconds and a minimum motor burning time of 3 seconds. The performance capabilities predicted for the DM-8D rocket were based on the following configuration characteristics.[15]

	DM-8D Rocket with 1,500-Lb. Payload	DM-8D Rocket with 1,170-Lb. Payload
Overall Length..............	296.6 inches	296.6 inches
Maximum Diameter............	30.0 inches	30.0 inches
Motor Diameter..............	22.9 inches	22.9 inches
Nozzle Exit Diameter........	19.8 inches	19.8 inches
Fin Span/Configuration......	55.0 inches/Delta	55.0 inches/Delta
Fin Size....................	25 X 17 inches	25 X 17 inches
Gross Weight................	4,781 pounds	4,451 pounds
Empty Weight................	2,978 pounds	2,648 pounds
Gross C.G.* (aft of nose)...	164.5 inches	170.0 inches
Empty C.G. (aft of nose)....	141.4 inches	147.8 inches

* Center of Gravity

(U) To achieve the desired improvement in deflection accuracy, the contractor proposed a spin system design based on the dispersion-cancellation principle, in contrast to the straight spin system used on the M31 rocket. The proposed design consisted essentially of two banks of four spin rockets each, spaced equally about the pedestal periphery, the second bank being oriented to counter the roll initiated by the first. This spin bucking system was designed to reduce substantially the latent angular dispersion resulting from thrust malalignment, and to decrease the rocket sensitivity to surface winds through reduction of rocket stability.

(U) At this early stage in the program, precise definitions of spin rocket characteristics were not available. However, preliminary estimates indicated a torque requirement of 4,800 foot-pounds per bank and a burning time of 0.20 seconds per bank, with ignition of the first bank 0.30 seconds after first motion, followed by ignition of the second at a roll position of 170 degrees. The two spin rocket banks would be

[15] Ibid., pp. 13-14, 26.

designed to have the same torque and burning times, thus requiring the development of only one spin rocket type.[16]

(U) Design and Development of the R&D Prototype (U)

(U) Scope and Objectives of the R&D Program (U)

(U) Based on results of the Phase I research tests and the approved supplementary design study described above, Douglas Aircraft proceeded with the Phase II and Phase III R&D effort outlined in its modified contract. The second phase of the reoriented program embraced the design and fabrication of a prototype spin rocket ignition switch and the necessary equipment for six spin jig tests to finalize the design of the spin buck system. Phase III included the design of all rocket components exclusive of the new motor and spin rocket metal parts, but including all airframe attachments for these motors; the review of all deviations from motor specifications to determine effects on the rocket system; and the performance of wind tunnel tests to finalize the rocket design.

(U) Upon approval of assembly drawings by the Redstone Arsenal, Douglas was to fabricate 92 improved rockets with concrete ballasts, less motors and spin rockets which were to be furnished by the Government. Seventy-four of these rounds were to be assembled and test fired at the WSPG to obtain data for preliminary firing tables and preparation of Ordnance ammunition-type drawings representative of the final design of the improved rocket. The remaining 18 rounds were to be reserved for engineer-user tests under Phase IV of the program, with the contractor responsible only for observation and analysis of the tests and incorporation of the resulting data in the final firing table.[17]

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[16] Ibid., pp. 16-18, 27.

[17] (1) Mod No. 2 to DAC Contr ORD-693, 18 Jul 56. HJ R&D Case Files, Box 13-562, RHA AMSC. (2) Also see above, pp. 100-102.

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(~~C~~) The reoriented improvement program, as approved by the CRD, called for completion of all R&D activities (i.e., developmental and engineering evaluation) by the end of June 1958. The achievement of improved system accuracy remained the prime objective of the program; increased range was second in importance and weight reduction was third. The Chief of Ordnance emphasized that the achievement of the secondary objectives at the cost of giving up mutual interchangeability of all rockets and launchers would not be acceptable. He noted, however, that an increase in range capability was desired, if possible; and therefore, an increase in weight up to that of the M31A1C rocket would be acceptable if necessary to achieve mutual compatibility.[18]

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(~~C~~) At the time the rocket program was reoriented to provide for development of the new XM-50 model, the XM-31E2 rocket had progressed to the point where it could be used as a test vehicle for the new spin system common to both rockets. In this light, 12 XM-31E2 rounds, modified to simulate the design parameters of the XM-50 rocket, were scheduled for research flight test in April 1957 to demonstrate the feasibility of the spin buck technique. Similar mockups would be used to demonstrate compatibility of the XM-50 rocket with the three tactical launcher systems.[19]

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(~~C~~) A strike at the plant of the motor metal parts manufacturer, coupled with subsequent restrictions on the use of overtime, delayed the completion of the research test phase from April to September 1957. Design problems then developed in the rocket motor, requiring a partial redesign and causing a delay in initial R&D flight tests of the complete

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[18](1) DF, CRD/C-7113, OCRD, DA, to CofOrd, 14 May 56, sub: HJ Imprv Prog. ORDTU File, May - Aug 56, FRC. (2) Ltr, 00/6C-23582, CofOrd to CG, RSA, 27 Nov 56, sub: same. ORDTU File, Sep - Dec 56, FRC.

[19](1) Ltr, CG, RSA, to CofOrd, 18 Mar 57, sub: Ord Proj TU2-1029 and Proj TU2-3008, Dev of an Imprv HJ Sys. ORDTU File, Jan - May 57, FRC. (2) HJ Msl Sys Plan, ARGMA MSP-11, 1 Jun 60, p. 38D. (3) ARGMA TR 1B1R, 15 Sep 59, sub: Honest John Project TW-200, Evaluation of Rocket, 762-mm., XM50, p. 2.

[redacted]

XM-50 rocket.[20] This section deals with development of the XM-50 rocket up to the first flight test in mid-June 1958.

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(Ø) Rocket Design Characteristics (U)

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(Ø) The Douglas Aircraft Company completed the basic design of the XM-50 rocket during the first quarter of CY 1957. By early April, the assembly of hardware for the spin buck feasibility tests was nearing completion, and the Redstone Arsenal had approved the release of sufficient drawings to permit tooling for fabrication of airframe components for the 92 XM-50 test rounds.[21] The design adopted for the XM-50 rocket (see sketch) differed from that of the initial DM-8D model in several important respects.[22] Among the major changes were an increase in motor burning time from 3 to 3.5 seconds; a decrease in payloads from 1,500 and 1,170 pounds to 1,500 and 1,000 pounds; a change in the fin size from 25 by 17 inches to 39.4 by 16.1 inches; and a slight increase in rocket length from 296.6 to 298.5 inches. The resultant changes in rocket weights were as follows:[23]

	XM-50 Rocket with 1,500-Lb. Payload	XM-50 Rocket with 1,000-Lb. Payload
Gross Weight*..............	4,760 pounds	4,260 pounds
Fuel Weight................	1,804 pounds	1,804 pounds
Empty Weight...............	2,934 pounds	2,434 pounds

* Excluding spin rocket propellant weight.

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[20] (1) RSA Semiannual Hist Sum, 1 Jan - 30 Jun 57 (2 Vols), II, 247. RHA AMSC. (2) HJ Hist Sum, FS thru 30 Sep 58, and Msl Sys Monthly Prog Rept, Oct 58, p. 8. (3) Also see above, pp. 77-78.

[21] RSA Rept, 1 Apr 57, sub: Status of Development Project (RCS ORDTX-113) - Proj TU2-1029, Improved Honest John Rocket XM50, n.p. ORDTU File, Jan - May 57, FRC.

[22] For the extent of rocket design changes made since the initial proposal in January 1955, compare the sketch of Model 1866 - Honest John "B" (page 104) with that of the XM-50 model (page 114).

[23] Addendum to DAC Rept No. SM-27103, 4 Apr 57, sub: Prelim Design Study of an Imprv HJ Rkt Model DM-8D, n.p. RSIC.

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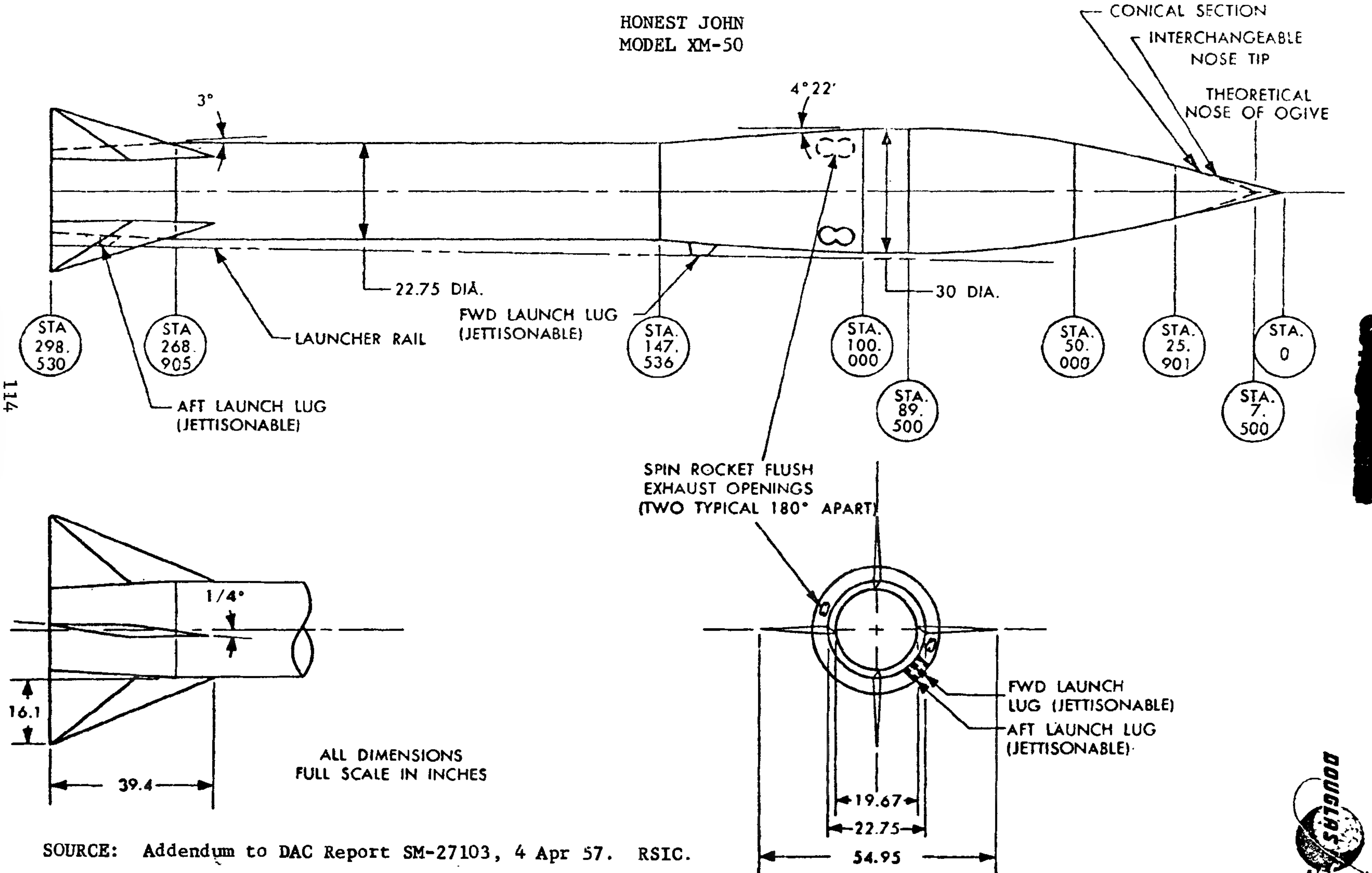
HONEST JOHN
MODEL XM-50



SOURCE: Addendum to DAC Report SM-27103, 4 Apr 57. RSIC.

(U) The XM-50 rocket delivered for R&D flight test in June 1958 closely approximated the design characteristics described above. It consisted of three major sections: (1) the head compartment (Station 0 to 115); (2) the pedestal section (Station 115 to 134), embracing the XM-37 spin rocket assemblies; and (3) the motor section (Station 134 to 298), taking in the XM-31 rocket motor and fin assembly.[24] A comparison of the XM-50 and M31A1 rockets as of April 1958 is shown in the cutaway views which follow.

(U) <u>Development of the Spin Buck System</u> (U)

(U) The Redstone Arsenal and the Douglas Aircraft Company initiated preliminary design studies of the improved spin buck system in April 1955. The XM-32 spin motor developed for use with the XM-31E2 rocket was originally designated as the .2DS-1,500 Jato, to specify that it was a solid propellant (cast double-base) rocket with a .2-second burning time and a 1,500-pound thrust.[25] The Picatinny Arsenal undertook design studies of such a rocket in January 1956, near the end of the research test program.

(U) In its study report of February 1956, the Picatinny Arsenal outlined four rocket designs that would comply with ballistic requirements, all of them based on the use of a 19-grain, mono-perforated charge of X-8* propellant composition. Design 4 (see drawing) was recommended for development because it was the most compatible with the standard pedestal assembly and therefore could be adapted to the XM-31E2 rocket without

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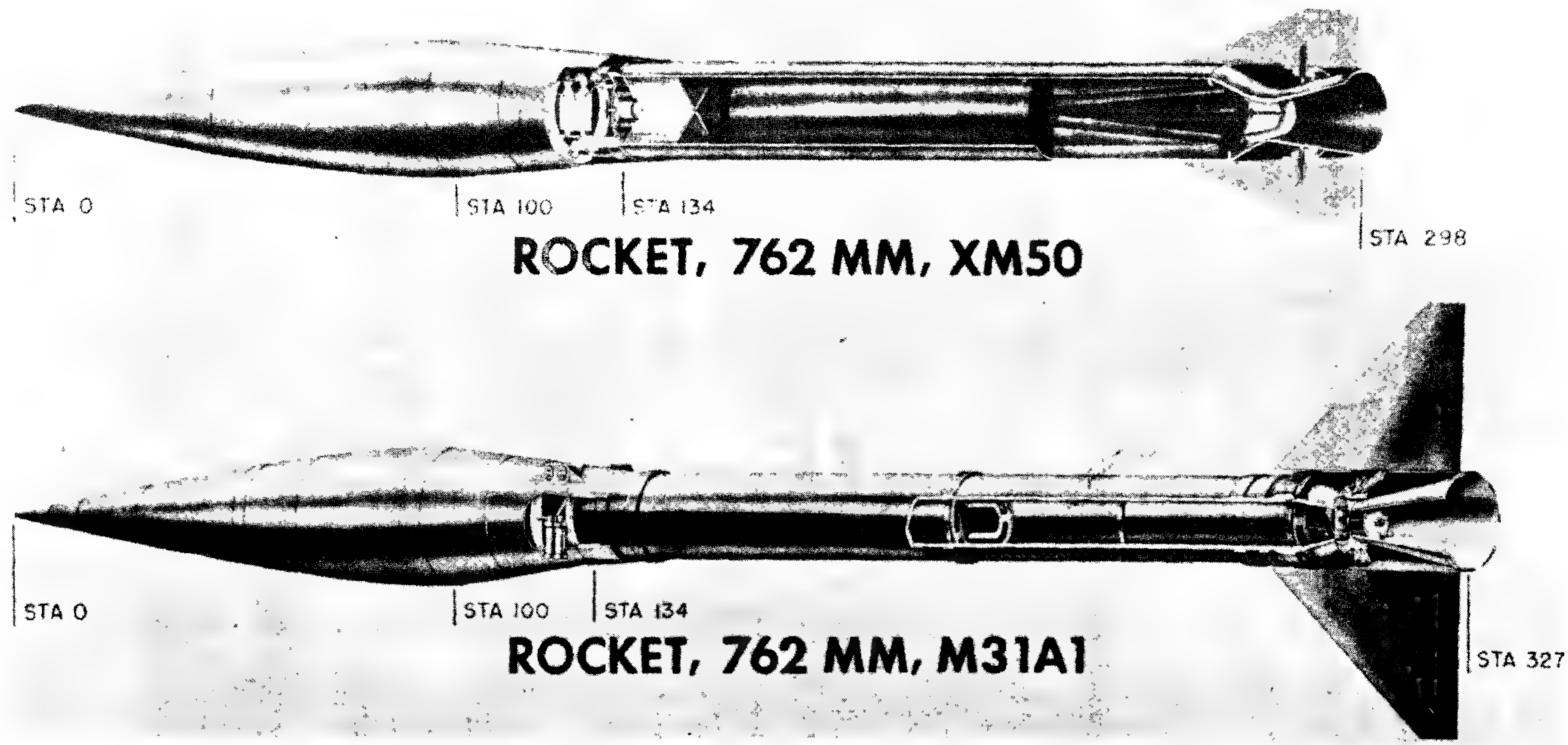
*(U) The X-8 composition is a standard double-base, solventless-extruded rocket propellant developed by the Navy. Its main ingredients are Nitrocellulose (50%) and Nitroglycerin (37.6%).

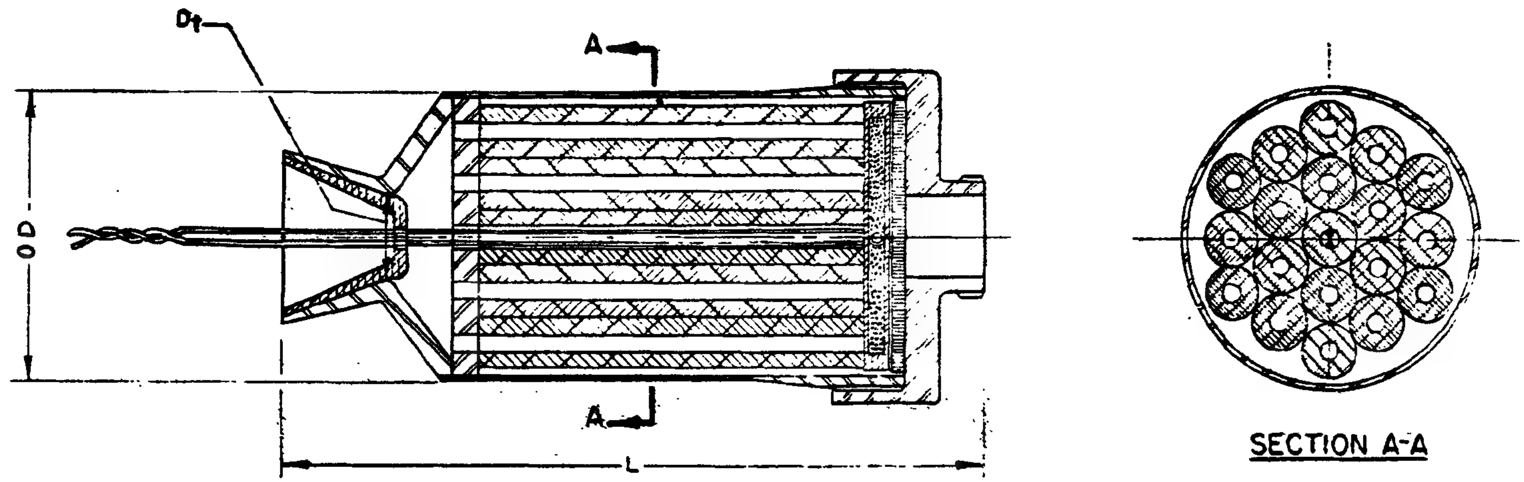
[24] ARGMA/OML Rept 3Y19, 17 Apr 58, sub: Comparison of 762-mm. Rockets, XM-50 and M31, pp. 3-10. RSIC.

[25] (1) Ltr, 00/5C-7814, CofOrd to CG, RSA, 8 Apr 55, sub: HJ Imprv Prog - RSA Rept No. 3M51P dated 11 Mar 55. ORDTU File, Jan - Apr 55, FRC. (2) Ltr, CG, RSA, to CofOrd, 9 Apr 57, sub: Jato Unit .2DS-1500 (Jato Unit XM-32). ORDTU File, Jan - May 57, FRC.



(U) Cutaway View: Honest John Rockets, XM-50 and M31A1 (April 1958)

SOURCE: ARGMA/OML Rept 3Y19, 17 Apr 58, sub: Comparison of 762-mm. Rockets, XM-50 and M31. RSIC.



PROPOSED DESIGN FOR SPIN BUCK SYSTEM FOR HONEST JOHN ROCKET

DESIGN	OD	D_t	L
1	2.656	0.754	6.60
2	2.656	0.543	4.47
3	2.656	0.774	6.63
4	2.656	0.787	6.98

—Recommended for adoption.

SOURCE: Picatinny Arsenal Technical Report 2325, February 1956, sub: Design Studies for Spin Buck System for the Honest John Rocket, p. 9.

extensive modification of existing hardware. The eight .2DS-1,500 jatos required (i.e., four jatos each for two spin directions) would be secured to the manifold at an acute angle so as not to protrude beyond the contour of the pedestal shell. Each jato would have a propellant weight of 0.640 pounds, a gross (loaded) weight of 4.11 pounds, and a burning time of 0.2-second with a total impulse of 135 pounds per second and a torque of 4,500 foot-pounds.[26] The Picatinny Arsenal indicated that the proposed spin motor could be developed up to the first flight test within 5 months at an estimated cost of $27,000. Included in this estimate was $15,000 for development and $12,000 for fabrication of 10 sets of metal parts (8 jatos per set) and sufficient propellant and igniters for 15 static tests and 6 spin jig tests.[27]

(U) The .2DS-1,500 jato unit subsequently developed by Picatinny Arsenal was designated as the XM-32 Jato on 23 October 1956.[28] Barely a week later, the Redstone Arsenal announced that this initial model had failed to pass ballistic tests. The results of some 40 XM-32 static firings indicated performance of a .2DS-1,300 jato, rather than that of the intended .2DS-1,500 motor. Moreover, aerodynamic design studies by Douglas Aircraft indicated that performance of the XM-32 jato would not meet spin requirements of the improved XM-50 rocket. Accordingly, the Redstone Arsenal requested the Picatinny Arsenal to finalize the design of the existing XM-32 jato for use in preliminary feasibility tests of the spin buck system, and to begin studies of a higher-thrust spin motor for the XM-50 rocket.[29]

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[26] Picatinny Arsenal TR 2325, Feb 56, sub: Design Studies for Spin Buck System for the Honest John Rocket, pp. 1-4, 7, 9, 13. RSIC.

[27] Ltr, CG, PA, to CG, RSA, 7 Mar 56, sub: Spin Buck Sys for HJ Rkt. ORDTU File, Jan - Apr 56, FRC.

[28] Ltr, CG, RSA, to CofOrd, 9 Apr 57, sub: Jato Unit .2DS-1500 (Jato Unit XM32). ORDTU File, Jan - May 57, FRC.

[29] Ltr, CG, RSA, to CG, PA, 31 Oct 56, sub: Jato Unit XM32, Imprv HJ Spin Bucking Rkt. HJ R&D Case Files, Box 15-95, RHA AMSC.

(U) At the end of 1956, the Picatinny Arsenal had already spent nearly $39,000 on development of the XM-32 jato; and it needed an additional $44,440 for completion of work on the XM-32 unit and development of the improved model.[30] On the same date, the Radford Arsenal had spent $20,335 on the XM-32 project and needed an additional $1,500 to cover remaining work.[31]

(U) The Picatinny Arsenal completed design studies of the improved .2DS-2,075 jato in late January 1957, and the Redstone Arsenal authorized development of the proposed jato in mid-February.[32] At about the same time, the Arsenal initiated procurement action for 818 sets of metal parts for the new jato unit; increased the procurement quantity of XM-32 metal parts from 100 to 182 sets; and made arrangements with the Ordnance Ammunition Command for the manufacture and loading of additional propellant charges by the Radford Arsenal.[33] By early March 1957, the Heckethorn Manufacturing & Supply Company had shipped all 182 sets of XM-32 jato metal parts and was procuring material for fabrication of the new jato units which were to be delivered at the rate of 300 sets in June, 300 in July, and 218 in August 1957.[34]

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[30] Ltr, CG, PA, to CG, RSA, 4 Jan 57, sub: Spin Buck Jatos for HJ. File same.

[31] Ltr, CO, Radford Ars, to CG, OAC, 7 Feb 57, sub: Unexpended Funds Allocated to Jato Unit, XM32. File same.

[32] (1) 1st Ind, CG, PA, to CG, RSA, 29 Jan 57, on Ltr, CG, RSA, to CG, PA, 4 Jan 57, sub: Jato Unit .2DS-2075, Imprv HJ Spin Bucking Rkt. (2) Ltr, CG, RSA, to CG, PA, 14 Feb 57, sub: same. Both in HJ R&D Case Files, Box 15-95, RHA AMSC.

[33] (1) Memo, Chf, Rkt Dev Labs, to Chf, P&C Div, 8 Feb 57, sub: Heckethorn Contr ORD-5005 for Fab of Metal Parts for Jato Unit XM32. (2) Ltr, CG, RSA, to CG, OAC, 20 Feb 57, cited in TT, CG, OAC, to CO, Radford Ars, 24 Jun 57. Both in HJ R&D Case Files, Box 15-95, RHA AMSC.

[34] (1) Ltr, Heckethorn Mfg & Supply Co, Littleton, Colorado, to CG, RSA, 1 Mar 57. (2) Tvl Rept, Lt M. L. Cohen, Rkt Dev Labs, OML, 11 Mar 57 [re trip to Heckethorn, 6 Mar 57]. Both in HJ R&D Case Files, Box 15-95, RHA AMSC.

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(Ø) Early in 1957, the Redstone Arsenal conducted a series of engineering tests to evaluate performance of the XM-32 jato, preparatory to the feasibility demonstration at the WSPG. The original plan for the latter program called for a minimum of 12 flight tests using XM-50 mock-ups (XM-31E2 rockets modified to simulate XM-50 weight and configuration, including the spin-buck package and 16-inch clipped fins). The feasibility demonstration began with the first firing on 27 May 1957, followed by two firings in July, four in August, and four in September 1957. Since the data obtained from these 11 firings satisfactorily demonstrated the feasibility of the spin buck system, the 12th scheduled firing was cancelled.[35]

(U) Meanwhile, the Picatinny Arsenal encountered technical difficulties in meeting the design specification for the improved XM-37 jato unit. It completed engineering qualification tests of the initial jato design (produced by Heckethorn) in the late summer of 1957. Based on the results of this evaluation and a series of component tests, the Redstone Arsenal released the R&D drawings for procurement of 500 XM-37 jato units under a $15,000 contract with the Packard Manufacturing Corporation.[36] With delivery of the first 50 units in October 1957, the XM-37 jato assembly underwent a series of design changes because of hydrostatic failure and other design deficiencies.[37] As a result, the amended contract price for 450 redesigned jatos was $15,385.50, plus

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[35](1) Ltr, CG, RSA, to CG, PA, 28 Feb 57, sub: Imprv HJ Spin Bucking Rkt, Jato Unit XM32. File same. (2) TT, DAC to CG, RSA, 11 Jul 57. File same. (3) HJ Fact Book, Feb 59, p. IV-41. (4) Also see Table II, Appendix A.

[36](1) 1st Ind, CG, PA, to CG, RSA, 12 Jul 57, on Ltr, CG, RSA, to CG, PA, sub: Jato Unit XM37. (2) 1st Ind, PA to RSA, 18 Nov 57, on Ltr, RSA to PA, sub: same. (3) Memo, Chf, Rkt Dev Labs, to Chf, P&C Div, 20 Dec 57, sub: Contr Nr DA-01-021-506-ORD-535, Packard Mfg Corp. All in HJ R&D Case Files, Box 15-95, RHA AMSC.

[37](1) TT 8383, CG, PA, to CG, RSA, 9 Oct 57. (2) TT 9183, same to same, 4 Nov 57. (3) Ltr, Packard Mfg Corp, Indianapolis, Ind., to CG, RSA, 25 Oct 57, sub: Contr ORD-535. File same.

$1,147.68 for new tooling. Added to this cost was $2,156 for 1,100 spacers, increasing the total contract value from the original $15,000 to $18,689.18.[38] Because of increased overhead and additional work not previously anticipated, development costs at the Picatinny Arsenal jumped from the original estimate of $14,300 to $27,000. As of early November 1957, it had already spent the initial allocation of $10,000 and needed $17,000 more to complete remaining work on the XM-37 jato.[39]

U (~~C~~) By the early spring of 1958, more than 125 XM-37 jato units had been fired in static and spin jig tests. Component tests of the unit continued until April 1958, at which time the Redstone Arsenal began qualification tests of the final spin buck rocket.[40] The Packard Manufacturing Corporation completed delivery of the 450 redesigned spin motors, and signed another contract, on 2 April, for production of an additional quantity of XM-37 metal parts and spacers.[41]

U (~~C~~) The redesigned XM-37 spin buck motor had a gross weight of 7.1 pounds, with a propellant weight of 2.08 pounds. It used a 10-pointed star propellant configuration measuring 2.93 inches in diameter and 9.13 inches in length. It had an average thrust of 1,988 pounds and a burning time of 0.183 seconds. The XM-37 motor featured a smokeless ARP double-base cartridge grain having an expected storage life of 5 to 15 years. In contrast, the M7 straight spin motor for the M31 rocket used a smoky single-base grain having a storage life of only 3 years.[42]

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[38](1) Ltr, Packard Mfg Corp to CG, RSA, 5 Nov 57, sub: Contr ORD-535 Re Mod No. 4. (2) Memo, Chf, Rkt Dev Labs, to Chf, P&C Div, 20 Dec 57, sub: Contr ORD-535, Packard Mfg Corp. File same.

[39]TT 9183, CG, PA, to CG, RSA, 4 Nov 57. File same.

[40]ARGMA/OML Rept 3Y19, 17 Apr 58, sub: Comparison of 762-mm. Rkts, XM-50 and M31, p. 29. RSIC.

[41](1) Ibid., p. 29. (2) Contract DA-010-21-ORD-5610, 2 Apr 58, FFP $25,706. Closed Out Contract Listings, MICOM, 1 Jul 64, p. 136. (3) Packard and Heckethorn also produced the M7 spin motor for the Basic M31 Rocket. Ibid., pp. 41, 58.

[42]ARGMA/OML Rept 3Y19, 17 Apr 58, pp. 6, 8. RSIC.

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(Ø) As late as 17 April 1958—exactly 2 months before the first XM-50 flight test—Ordnance Corps personnel were convinced that the (XM-37) spin buck system, together with the new fin design, would provide the desired improvement in deflection accuracy.[43] However, as will be noted later, the dispersion-cancellation or spin buck technique failed to meet system accuracy requirements and was dropped in April 1959 after some 32 XM-50 flight tests.[44]

U
(Ø) Motor Improvement Program (U)

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(Ø) The Redstone Arsenal initiated preliminary design studies of a new power plant for the Honest John rocket in the early spring of 1955.[45] The original program plan, approved in early April, called for the redesign of motor metal parts and development of an improved propellant grain having a higher specific impulse and increased firing, storage, and handling temperature limits of -40°F. to 120°F. The new rocket motor was expected to bring the range accuracy of the Honest John within prescribed limits and, in concert with the new fin-spin system, to reduce the azimuth probable error attributable to low level wind effects. It would also permit a substantial increase in range capability and ease many of the logistical problems being experienced with the standard M6A1 motors then in the field.[46]

(U) The Picatinny Arsenal and the Allegany Ballistics Laboratory (ABL) conducted feasibility studies and submitted proposals for the

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[43] Ibid., pp. 10-11, 15.

[44] See below, pp. 135ff.

[45] (1) Ltr, 00/5C-7213, CofOrd to CG, RSA, 1 Apr 55, sub: HJ Imprv Prog. (2) Ltr, 00/5C-7814, same to same, 8 Apr 55, sub: HJ Imprv Prog - RSA Rept #3M51P dated 11 Mar 55. Both in ORDTU File, Jan - Apr 55, FRC.

[46] (1) RSA Rept 3M51P, 11 Mar 55, sub: Prelim HJ Sys Imprv Prog, pp. 1, 4, 9-12. RSIC. (2) For details relating to tactical limitations of the Basic Honest John, see Mary T. Cagle, History of the Basic (M31) Honest John Rocket System, 1950 - 1964 (MICOM, 7 Apr 64), pp. 113-18, 217-18.

improved motor design in early May 1955. The Redstone Arsenal accepted the ABL design and was ready to begin development in June, when the motor improvement program was suddenly cancelled.[47] A year later, in May 1956, the Army General Staff reinstated the motor program, and the Arsenal received formal guidance to that effect in early June.[48]

(U) In the 2 years that followed (June 1956 - June 1958), the improved XM-31 motor was designed and developed under the technical direction of the Redstone Arsenal (ARGMA, after 1 April 1958), with the Ordnance Missile Laboratories serving as prime contractor. In addition to preparing the basic rocket design requirements and characteristics, the Douglas Aircraft Company fabricated the ogive ballast head and the fin and pedestal assemblies, and conducted dynamic tests at the WSPG. The ABL designed and developed the interior ballistics of the motor and served as a consultant to the prime contractor, along with Douglas Aircraft. Propellant grains for the motor were manufactured and loaded by the Radford Arsenal, a Government-owned facility operated by the Hercules Powder Company. The Emerson Electric Manufacturing Company engineered and manufactured the XM-31 motor metal parts, including the launcher shoes, fin mounting ring, and nozzle fairing.[49]

(U) Developers of the new rocket motor were guided in their initial effort by technical requirements set out by the Redstone Arsenal in June 1956, and the preliminary rocket design characteristics established 2 months later by Douglas Aircraft. In April 1957, Douglas published an addendum to its preliminary design study report, outlining certain changes in rocket design and theoretical performance characteristics.[50]

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[47] (1) RSA Rept No. 433, 25 Dec 55, sub: Proj Plan for Dev of an Imprv HJ Sys, pp. 3-4. RSIC. (2) Also see above, pp. 69-72.

[48] See above, pp. 73-75, 101, 108-110.

[49] (1) HJ Msl Sys Plan, ARGMA MSP-11, 1 Jun 60, p. 4A. (2) Also see Chart 5, p. 91, and List of HJ Contracts in Appendix B.

[50] For details, see above pp. 108-110, 113-15.

(U) The engineering design effort at the ABL progressed on schedule until early March 1957, when motor case deliveries were interrupted for more than 2 months by a strike at the Alco Products Company (subcontractor to Emerson).[51] At about the same time, the ABL experienced some difficulty in machining the core of the XM-31 Jato; however, this was soon overcome and the first motor was successfully static tested on 11 April 1957.[52] The program then suffered a far more serious setback in November 1957, when it was determined that the 1031 type steel being used in the motor case was not compatible with the stringent weight and balance requirements of the rocket. Emerson Electric redesigned the motor metal parts using a heat-treated 4130 material, and began deliveries of the lightweight XM-31E1 motor in March 1958. The Redstone Arsenal began design proof tests of the motor metal parts in April. By that time, the basic propellant design had been completed with 15 static tests conducted across the temperature ranges of -40°F. to 130°F.[53]

(U) While further design changes would later be required, the XM-31E1 rocket motor used in initial XM-50 flight tests possessed several notable improvements over the standard M6 Jato. First, and perhaps most important, it used an improved ARP single-perforated propellant grain capable of producing a maximum thrust of 118,000 pounds. It had the same diameter as the M6 Jato (22.8 inches), but was 33 inches shorter and 1,015 pounds lighter, most of this weight reduction being achieved through the simplification of metal parts design. Another design

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[51](1) TT ORDDW-MKP-3070, CG, RSA, to CofOrd, 18 Mar 57. (2) DF Cmt 2, CRD to DCSLOG, 10 Apr 57, sub: Effect of Alco Strike on HJ Imprv Prog. (3) Cmt 4, DCSLOG to CofOrd, 30 Apr 57, sub: same. All in ORDTU File, Jan - May 57, FRC.

[52](1) Rept, "Status of Development Project . . . Improved HJ Rocket XM50," 1 Apr 57. (2) TT, ORDDW-MKP-4050, CG, RSA, to CofOrd, 16 Apr 57. Both in ORDTU File, Jan - May 57, FRC.

[53](1) HJ Msl Sys Plan, ARGMA MSP-11, 1 Jun 60, p. 2A. (2) ARGMA/OML Rept 3Y19, 17 Apr 58, sub: Comparison of 762-mm Rkts, XM50 and M31, p. 28. RSIC.

refinement was the use of a welded nozzle instead of one requiring attachment by 56 bolts and precision machining for all mating surfaces of the nozzle and aft end of the motor shell. These and other innovations too numerous and complex to mention allowed much better weight tolerances to be maintained, as compared with the weight variations of the M6.[54]

U ~~(C)~~ Warhead Development (U)

(U) Aside from the ballast (inert) head section designed for use in the XM-50 development test rounds, this phase of the Honest John Improvement Program was primarily concerned with the improvement of standard warheads and with continued R&D work on the chemical warhead. Among the warheads developed for use with both the M31 and M50 rockets were (1) the new XM-27 (M27) atomic head; (2) improved models of the T2044 high explosive head—later standardized as the M144 to replace the old M6 (T2043E1) head; (3) the optimum XM-38 (M38) flash-smoke practice head to replace the XM-4E4; and (4) the E19R2 (M190) chemical warhead. An improved version of the M144—the XM-186—was also developed, produced, and delivered to the field as LP type. Standardization of the XM-186 was expected in the first quarter of FY 1966.[55]

U ~~(C)~~ The Chemical Corps actually began development of the chemical head in 1952; however, the project was beset with technical difficulties, and an acceptable model still had not been achieved when the M31 system was deployed in 1954.[56] Realizing that the existing warhead design

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[54] Ibid., pp. 6, 9.

[55] (1) Cagle, History of the Basic (M31) Honest John Rocket System, 1950 - 1964 (MICOM, 7 Apr 64), pp. 121-22, 136, 139. (2) AMCTCM 2621, 17 Jun 64, RSIC. (3) AMP FY 1964 - 71, May 65 (draft), p. 244. HJ Cmdty Ofc Files.

[56] (1) Cagle, op. cit., pp. 56-57, 92-94. (2) Ltr, Army Cml Cen, Md., thru Chf Cml Off, to DCSLOG, 13 Dec 54, sub: Allocation of HJ Rkts for CmlC Warhead Tests. ORDTU File, Sep - Dec 54, FRC.

could not be adapted to the improved XM-50 rocket, the Chemical Corps then shifted its effort to the design of a new model that would be compatible with both rockets. The E19R2 interchangeable head was originally scheduled for completion by mid-1960, but continuing technical difficulties delayed the program some 4 years. It was finally standardized as the M190 Gas, GB Warhead Section on 17 June 1964—about 3 years after deployment of the improved Honest John rocket.[57]

(U) R&D Milestone Reached

(U) The Ordnance Missile Laboratories reported, on 17 April 1958, that the XM-50 rocket program had "progressed to a point where adequate research, static testing, and design have been accomplished to confirm the original estimated improvements . . . ." At that time, the design of the XM-50 rocket had been completed and the fabrication of flight test hardware was well underway.[58] Several months earlier, the XM-50 deployment or Ordnance readiness date had been extended from December 1959 to May 1960, and new target dates had been established as follows: July 1958 - first aerodynamic flight test; October 1958 - release for warhead test; December 1958 - conditional R&D release; May 1959 - statement of accuracy; and October 1959 - final R&D release.[59]

(U) By 1 June 1958, sufficient motor qualification tests had been completed to permit release of the first XM-50 flight test round some 30 days ahead of schedule. In preparation for the flight test phase of the XM-50 development program, compatibility of the rocket with the XM-33, M289, and M386 launchers had been demonstrated in operational tests using XM-50 mockups (standard M31 rounds modified to simulate

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[57](1) HJ Prog Rept, Nov 58, pp. 3-4. (2) AMCTCM's 364, 13 Dec 62; 2621, 17 Jun 64. RSIC.

[58]ARGMA/OML Rept 3Y19, 17 Apr 58, pp. 26-30 (quoted passage, p. 30).

[59]See above, pp. 77-78.

XM-50 weight and external configuration). These operational tests would have to be repeated with the XM-50 rocket in the course of the flight test program. The original flight test plan called for a total of 132 XM-50 firings, the first 84 rounds to be flown from the M386 launcher followed by 24 rounds each from the XM-33 and M289 launchers. The initial firings in the 84-round group would be used to prove the design and isolate any problem areas preparatory to the conditional R&D release; the remaining rounds would be used to demonstrate accuracy of the rocket and to form the basis for preliminary R&D range tables with the M386 launcher. Forth-eight rounds would then be fired from the other two launchers to establish correlation data for the final range tables.[60]

(U) Flight Test Program (U)

(U) In mid-June 1958, the Pentagon spotlight was focused on the White Sands Missile Range[*] (WSMR), where the first XM-50 rocket was about to be fired under circumstances reminiscent of the M31 demonstration 7 years earlier.[61] In June 1958, as in June 1951, the Honest John project was undergoing a critical top-level review to determine whether it should be terminated or funded to completion. The Army Chief of Staff had begun a detailed review of the XM-50 program in early January 1958, following a reported slippage of some 5 months in the Ordnance readiness date. The fate of the project was yet in doubt and funding guidance for the fiscal year beginning 1 July 1958 was still being withheld when the Honest John test crew began the countdown for the first

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[*] Formerly the White Sands Proving Ground; renamed effective 1 May 1958. DAGO 14, 19 Apr 58.

[60] (1) ARGMA/OML Rept 3Y19, 17 Apr 58, pp. 27, 29-30. RSIC. (2) ARGMA/OML TR 1B1R, 15 Sep 59, sub: Project TW-200 - Evaluation of Rocket, 762mm, XM50, p. 2.

[61] See Cagle, History of the Basic (M31) Honest John Rocket System, 1950 - 1964 (MICOM, 7 Apr 64), pp. 35-38, 45-46.

XM-50 firing on 17 June. The funding crisis ended 14 weeks and 11 flight tests later, just as the ARGMA was preparing to terminate the program.[62]

U (~~C~~) During the period 17 June 1958 to 16 July 1959, a total of 88 XM-50 rockets were expended in the R&D-engineering-user test program. Sixty-nine of these rounds were flight tested as a part of the rocket development effort, 7 were used for warhead development purposes, and the last 12 rounds were fired by the Artillery Board at Fort Bliss, Texas. The 81 rocket development and user test rounds carried the lightweight, concrete ballast payload simulating the weight of the XM-27 warhead. Of the seven warhead development rounds, four were flight tested with the T2044 (M144) head, two with the E19R2 chemical head, and one with the XM-27 head.[63]

U (~~C~~) <u>Conditional R&D Release</u> (U)

(U) In a normal telescoped program, the developing agency recommends the conditional R&D release of a new item when it has conducted sufficient flight tests to state with a reasonable degree of assurance that no major design changes are anticipated. The object of this stepped-up procedure is to speed the delivery of tactical hardware by entering into production before completion of development and product engineering.[64]

U (~~C~~) The Ordnance Missile Laboratories recommended the conditional

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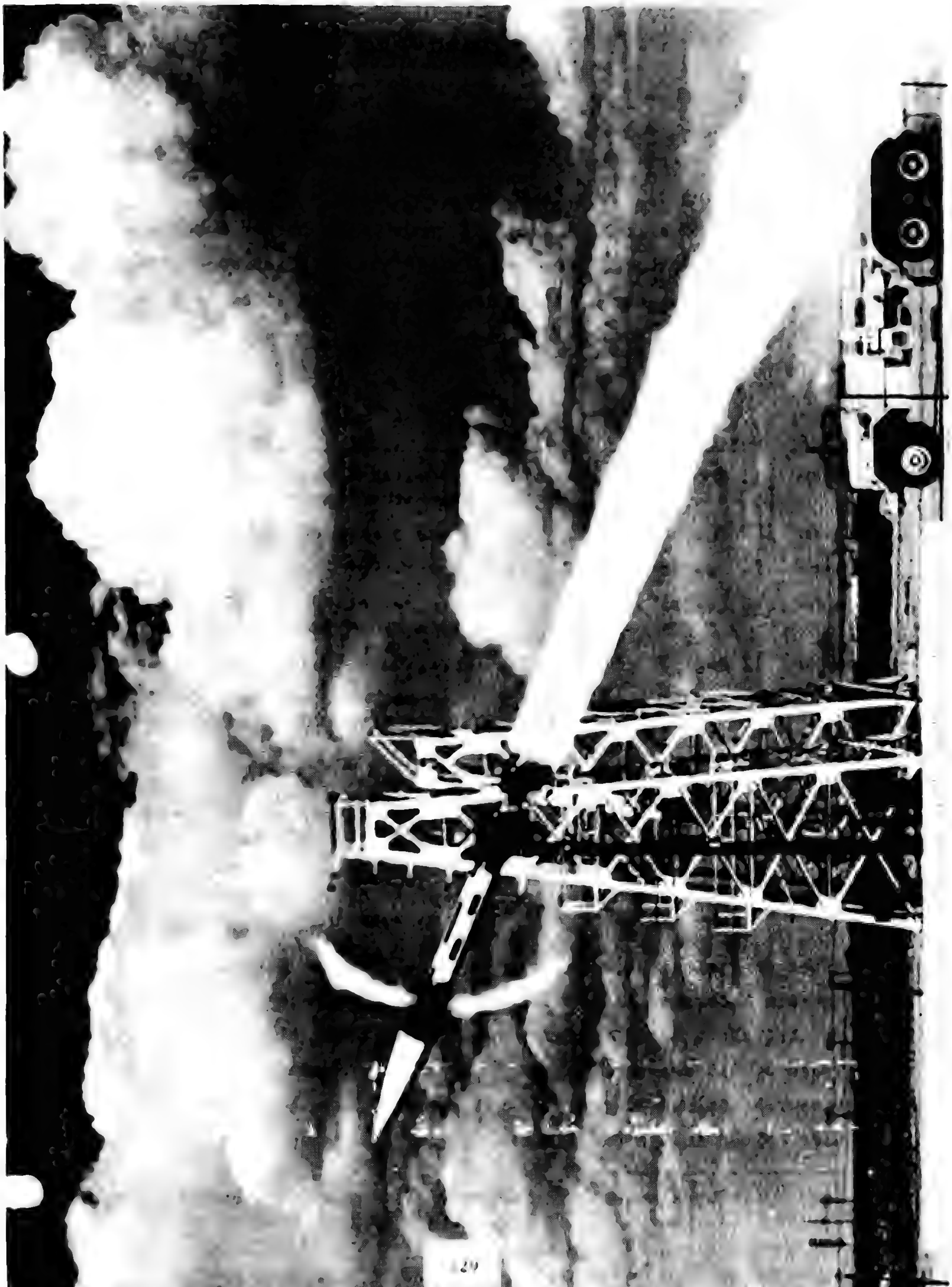
[62] For detailed coverage of the funding crises in 1958 and subsequent years, <u>see</u> above, pp. 77-88.

[63] ARGMA/OML TR 1B1R, 15 Sep 59, p. 7. RSIC.

[64] Under conventional programming, the R&D prototype is subjected to a series of engineering tests to determine its operational suitability and to pinpoint design deficiencies requiring correction. The mandatory design changes are incorporated and tested in succeeding R&D prototypes. Production-engineered drawings of the final tactical model are then released for industrial procurement.



R&D release of the XM-50 rocket in early September 1958, after a fairly small sampling of eight flight tests. These development test rounds used the XM-37 spin buck jato and the XM-31E1 rocket motor. All of them except the unnumbered round were fired from the improved M386 self-propelled launcher at the WSMR. The odd round was fired in a special warhead test at the Yuma test range in Arizona. An abbreviated summary of the 8-round test program follows.[65]

Rd Nr	Date Fired	GT (°F.)	QE	Remarks
1-RO	17 Jun 58	72.0	50.0°	Pedestal doors blown off at launch; Premature ignition of spin buck jatos
2-RO	9 Jul 58	104.5	6.0°	Spin buck rockets failed to function
3-RO	24 Jul 58	79.5	22.5°	Successful
4-RM	6 Aug 58	87.0	22.5°	Successful—First test of XM-50 round with T2044 (modified M6) warhead
5-RO	12 Aug 58	120.0	22.5°	Premature ignition of spin buck jatos
----	19 Aug 58	92.0	17.0°	Unnumbered round with XM-27 warhead fired from M289 launcher at Yuma test range
6-RO	25 Aug 58	-30.0	22.5°	Successful
7-RO	25 Aug 58	-30.0	22.5°	Premature ignition of spin buck jatos

Legend: GT - Grain Temperature
QE - Quadrant Elevation or launch angle
RO - R&D round with lightweight ballast warhead
RM - R&D round with T2044 warhead

After analyzing the results of these tests, the Director of the Ordnance Missile Laboratories concluded that all components of the XM-50 rocket met the basic design requirements. In support of the conditional release of R&D drawings, he wrote: "The performance estimates [based on research firings of modified M31 rockets] have been confirmed by flight test. Even though the [initial XM-50] rounds were not tested for

[65](1) WSMR Annual Hist Report, Jan - Dec 58 (2 vols), I, 94-96. (2) Progress Chart: XM50 Firings, incl to Ltr, A260-HJ-AN-74, DAC to CG, AOMC, 13 Aug 59. HJ R&D Case Files, Box 13-562, RHA AMSC.

accuracy no unusual dispersions have occurred." Obviously referring to malfunctions of the spin buck jato in four out of eight trials, he added: "Development problems will be encountered; however, there is at this time reasonable assurance that these problems will not have a major effect on the rocket design."[66]

(U) At the time of the above proposal, the XM-50 program was still under review and FY 1959 funding guidance was yet to be received. The development program remained in a questionable status until early October 1958, when the ARGMA learned that the project would be funded to completion.[67] Later in October, the R&D Division effected the conditional release of XM-50 drawings for FY-1959 procurement of 204 R&D rounds to support the integrated test program. This brought the total R&D procurement in FY 1958-59 to 334 rounds—243 for R&D flight tests, 45 for engineering tests, 42 for service tests, and 4 (inert rounds) for Field Service use.[68]

(U) Spin Buck Rocket Failures (U)

(U) Meanwhile, the Honest John test crew resumed R&D firings of the XM-50 rocket in late September, after a 28-day lay-off. Beginning with Round 8-RO, fired on 23 September 1958, primary emphasis was placed on correction of design deficiencies revealed in the initial XM-50 firings. Of prime concern were technical difficulties experienced with the spin buck concept which had been adopted on the premise that it, together with the new fin design and improved rocket motor, would provide the desired improvement in range and deflection accuracy. The spin buck or

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[66] DF, Dir, OML, thru ARGMA Control Ofc, to R&D Div, 4 Sep 58, sub: Ord Proj TW-200, Cond R&D Release of XM50 Rkt.

[67] Cmt 2, Chf, ARGMA Control Ofc, to Chf, R&D Div, 1 Oct 58, on DF, AOMC Control Ofc to Comdr, ARGMA, 30 Sep 58, sub: Imprv HJ.

[68] OTCM 37178, 17 Sep 59. RSIC.

dispersion-cancellation system, it will be recalled, consisted of two sets (banks) of four spin rockets each, spaced equally about the pedestal periphery. The first bank, like the straight or monotonic spin, initiated roll as the rocket cleared the launcher. The second bank was then ignited at a pre-selected roll position to stop the roll at about one-half revolution and to cancel the accumulated dispersion by applying spin torque in the opposite direction. The technical feasibility of the spin buck system had been successfully demonstrated the year before in 11 research firings using modified M31 rockets. Yet the same spin system had malfunctioned in half of the first eight XM-50 firings.[69]

U (Ø) That the Ordnance Missile Laboratories had grossly underestimated the gravity of the spin problem became evident in late 1958, shortly after resumption of the R&D test program. Ignition failure of spin bucking (second bank) rockets occurred in the flight test of Round 8-RO on 23 September, and again in Round 10-RO fired on 30 September. Rocket development tests continued at a slow pace until early November 1958, when an attempt was made to accelerate the program. Because of continuing technical difficulties, the test program in December 1958 was limited to two firings of special test vehicles to provide basic design data. An analysis of this supplementary data revealed that the spin-buck roll inertia switch was drifting between first rocket motion and first spin rocket action, and that this drift was adversely affecting the precision of the spin-buck action. Further study yielded a possible solution to this problem, and flight tests were resumed with two more special firings (Rounds 21- and 22-RO) on 22 January 1959.

U (Ø) The fact that a major accuracy problem was still inherent in the XM-50 rocket design was clearly indicated by Rounds 24- and 25-RO, fired on 10 February 1959. Even though the spin buck system worked satisfactorily, these rounds had a range separation of 5,988 meters, one impacting at an unexplained short range of 23,943 meters and the

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[69] See above, pp. 110-13, 120, 130.

[redacted]

other at a longer range of 29,931 meters. This problem had to be resolved before development could continue.[70] Consequently, the 30-round accuracy test program was rescheduled to begin on 1 April 1959, and the target date for release of the weapon system accuracy statement was moved up from May to 15 July 1959.[71]

U
(Ø) Technical Review of the XM-50 Rocket Design (U)

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(Ø) In view of the short time remaining to demonstrate acceptable accuracy performance, the Director of the Ordnance Missile Laboratories, in mid-February 1959, formed an Ad Hoc Committee to make a complete technical review of the rocket design, and urged all agencies participating in the program to lend their full support to this group. In a letter to the Douglas Aircraft Company, on 17 February, the chief of the Program Control Office reiterated that the primary purpose of the XM-50 rocket program was to improve accuracy to the maximum extent possible as compared to the M31 rocket. Referring to the up-coming accuracy tests in early April, he emphasized that immediate effort must be exerted to provide maximum assurance that the desired accuracy improvement will be achieved. "Mediocre improvement," he declared, "is not acceptable."[72]

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(Ø) While the design review was in progress, research work continued on a parallel basis to resolve deficiencies in the spin-buck system. During a meeting held at the ARGMA, 17-19 February, Douglas Aircraft reported that the problem associated with the roll inertia switch had been solved by embedding a strong magnet in the rotor and switch housing. With regard to the range bias exhibited in Round 24-RO on 10 February,

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[70](1) Progress Chart: XM50 Firings, incl to Ltr, A260-HJ-AN-74, DAC to CG, AOMC, 13 Aug 59. HJ R&D Case Files, Box 13-562. (2) ARGMA/OML TR 1B1R, 15 Sep 59, pp. 2-5. (3) Also see Table VIII, Appendix A.

[71]Min, XM-50 Rkt Dev Mtg, ARGMA, 17-19 Feb 59, p. 4. HJ R&D Case Files, Box 13-562, RHA AMSC.

[72]Same letter sent to ABL, et al. HJ R&D Case Files, Box 13-562, RHA AMSC.

[redacted]

a company engineer explained that the short range had been caused by a roll pitch coupling phenomenon which probably could be overcome by increasing the fin cant from $1/8^{\circ}$ to $1/2^{\circ}$. This would be determined, he said, after a third nudger test firing in March.[73]

U (~~C~~) The results of subsequent research firings showed that neither problem had been solved. Telemetry records of two flight tests (26- and 27-RO), on 20 February, revealed that the fix applied to the roll inertia switch was not successful. One of these rounds carried six switches and the other carried five; yet simultaneous ignition of the spin and spin-buck jatos occurred in both flights. Telemetry data from the third nudger test (29-RO), on 16 March, indicated erratic motion.[74]

U (~~C~~) In view of the continuing technical difficulties, the Ad Hoc Committee concluded that the XM-50 rocket with a spin-buck system would not be acceptable from an accuracy standpoint. It therefore recommended in late March 1959 that a straight (monotonic) spin system be considered as an alternate approach. This type of system would provide a high initial spin rate that would continue throughout the burning phase at a rate well above the natural yaw frequency. An analysis of available test data indicated that the continuous spin rate in one direction would override most nonstandard effects that were serious to the spin buck system in its no-roll condition for the first 2 seconds of flight.[75]

(U) This eleventh-hour shift in technical approach set the rocket program back nearly 6 months and caused a considerable increase in R&D

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[73] (1) Min, XM-50 Rkt Dev Mtg, ARGMA, 17-19 Feb 59, pp. 4-5. File same. (2) The "nudger" test vehicle featured spin rockets mounted axially in the nozzle section to cause a yaw at two points in the trajectory. The first such round (13-RO) was fired on 10 October 1958, and the second (20-RO) on 16 December. Telemetry data from the latter test were lost. See Table VIII, Appendix A.

[74] Progress Chart: XM50 Firings, incl to Ltr, A260-HJ-AN-74, DAC to CG, AOMC, 13 Aug 59. HJ R&D Case Files, Box 13-562, RHA AMSC.

[75] ARGMA/OML TR 1B1R, 15 Sep 59, pp. 3, 9-10. RSIC.

costs. In the final analysis, the research tests conducted with XM-50 mockups (modified M31 rockets) were of little or no benefit to the final XM-50 rocket design, and had to be repeated under pressure of an extremely tight schedule. The cost of this additional R&D effort was estimated at $2,222,000.[76] Many important lessons were no doubt learned from this experience; but the real moral of the story is succinctly stated in this retrospective evaluation: "Research tests must be made with a design that approaches closely that of the expected end item or else the decisions based on the results of the research program approach postulation."[77]

U (~~S~~) Research Tests of Straight Spin System (U)

U (~~S~~) The Honest John test crew at the WSMR conducted the first two experimental flight tests with the monotonic spin system (Rounds E1-RO and E2-RO) on 25 March 1959. The following day a final effort was made to determine the suitability of the spin-buck system in the flight test of Rounds 31- and 32-RO. As recommended by the Ad Hoc Committee, the Director of the Ordnance Missile Laboratories dropped the spin buck system from active consideration and made arrangements to conduct 10 research firings of the straight spin system on a highly accelerated basis.[78]

U (~~S~~) Research firings of the XM-50 rocket with a conventional straight system began on 9 April and continued through 5 May 1959. (Rounds E3- through E12-RO). The data obtained from these 10 firings indicated that accuracy in the deflection plane was acceptable; however,

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[76] Rept on Status of HJ Imprv Prog, 12 Feb 60, n.p. HJ R&D Case Files, Box 13-563, RHA AMSC.

[77] HJ Msl Sys Plan, ARGMA MSP-11, 1 Jun 60, p. 38D.

[78] (1) Progress Chart: XM50 Firings, incl to Ltr, DAC to CG, AOMC, 13 Aug 59. HJ R&D Case Files, Box 13-562, RHA AMSC. (2) ARGMA/OML TR 1B1R, 15 Sep 59, pp. 3, 5, 17. RSIC.

this was not true of range accuracy.[79] Effective 6 May, the Director of the Ordnance Missile Laboratories abolished the Ad Hoc Committee, through whose efforts many of the deficiencies in the XM-50 rocket had been successfully defined and corrected. The Systems Analysis Laboratory assumed responsibility for the final analysis of flight test data to pinpoint and correct remaining deficiencies in the system.[80]

U (~~C~~) XM-50 Design Refinement (U)

U (~~C~~) A study of the results of Rounds E9- and E10-RO disclosed that the burning of residual propellant after major thrust decay had contributed to a range error of about 2,000 meters. The XM-31E1 motor then in use had a 115-pound sliver of live propellant. Based on the delivered total impulse of the motor, it was determined that more than 70 pounds of live slivers were in the motor at burnout. Since this live propellant sliver was considered to be the source of the low drag condition, an 85-percent inert sliver was developed for the modified XM-31E2 motor. A quantity of XM-31E1 motors had to be reworked before the flight test program could continue.

U (~~C~~) Meanwhile, the Systems Analysis Laboratory took positive actions to correct the deficiency in the spin rocket ignition circuit. It was determined by experiment that the voltage of the BA 605/U battery did not reach the minimum requirement of 12 volts in less than 0.3 second. This battery deficiency accounted for the considerable variation in spin rocket delay times previously recorded. As an R&D expedient, until an adequate power source could be provided, the pins of the battery were pulled by a 500-foot lanyard from the firing site. Solenoids were later mounted on the launcher to actuate the battery.

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[79] Ibid., pp. 17-18.

[80] DF, Dir, OML, to Chf, Prog Control Ofc, 30 Apr 59, sub: XM50 Ad Hoc Committee. HJ R&D Case Files, Box 14-125, RHA AMSC.

(U) Four XM-50 rounds (E13/14, E16/17-RO), with the XM-31E2 motor and other design refinements, were flight tested at the WSMR on 2 and 5 June 1959. An analysis of these tests showed that the inert propellant sliver had solved the range problem, the maximum range spread for the four rounds being less than 400 meters. In conjunction with these firings, the fourth T2044 warhead round (E15-RM) was successfully flight tested on 2 June 1959. Accordingly, the Director of the Ordnance Missile Laboratories decided to continue with the flight test program in support of a July 1959 statement of accuracy. Accuracy tests of the modified XM-50 rocket were resumed with the firing of Round E18-RO on 19 June 1959. The last test firing in the R&D accuracy series (Round E37-RO) was conducted on 2 July 1959.[81]

(U) <u>R&D Accuracy Analysis</u> (U)

(U) A total of 34 XM-50 rounds were fired in the R&D accuracy test program, but 4 of these were not valid for accuracy analysis. Rounds E1- and E2-RO were ruled out because of a nonstandard fin cant and contradictory surface wind data; E26-RO because of a spin rocket failure; and E32-RO because of a pedestal door failure. Thus, for accuracy analysis purposes there remained 30 rounds, all of which were fired from M386 launchers at a nominal grain temperature of 77°F. All of the rounds were equipped with the conventional straight spin system. They were fired in a sequence of three group samples to evaluate performance at maximum, medium, and minimum ranges. The first 12 rounds were launched at a quadrant elevation of 22.5° (400 mils), the next 9 rounds at 11.25° (200 mils), and the last 9-round sample at 45.0° (800 mils). Following is an analysis of the three samples.[82]

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[81](1) ARGMA/OML TR 1B1R, 15 Sep 59, pp. 17-20, 25, 35, 41. RSIC. (2) Ltr, DAC to CG, AOMC, 3 Sep 59, sub: Contr ORD-693, Model XM50 Rocket - R&D Accuracy Analysis. HJ R&D Case Files, Box 13-562, RHA AMSC.

[82](1) <u>Ibid</u>. (2) ARGMA/OML TR 1B1R, pp. 41, 43, 46.

SAMPLE			Mean Range	Mean Probable Error	
Period Fired	Nr Rds	QE	(meters)	Deflection	Range
4/9 - 6/5/59	12*	22.5°	24,938	5.5 mils	250 meters
6/19 - 6/22/59	9	11.25°	15,276	8.8 mils	336 meters
6/26 - 7/2/59	9	45.0°	255	7.2 mils	293 meters

*First 8 rounds equipped with XM-31E1 motor; all subsequent rounds carried the XM-31E2 motor with inert sliver and other refinements.

(U) An evaluation of experimental data showed that the improved XM-50 rocket was superior to the M31 rocket when considered as a tactical weapon. As shown in the accompanying comparison summary, the XM-50 rocket offered a substantial accuracy improvement in every dimension with exception of the range dimension when an altitude fuze is used. The maximum range of the XM-50 was about 13,000 meters greater than the M31 rocket; however, a 600-meter degradation of the minimum range resulted when the high performance of the XM-50 rocket was combined with the 8-second minimum arming time of the XM-27 warhead.[83]

(U) Among other notable improvements was a significant extension in low temperature limits. The suitability of the XM-50 system for operation in extremely cold climates was demonstrated in Arctic tests conducted at Fort Greely, Alaska, during the winter of 1958-59. The Arctic Test Board received two crated XM-50 R&D rounds on 5 December and left them in open storage until 12 January 1959, when the rockets were removed from the crates for further cold tests. In operational tests that began in February, both rounds were transported about 200 miles on improved and unimproved roads. They were then successfully flight tested on 4 March with only minor deficiencies noted. No heating blankets were used with power during the operation; a blanket was used on one round as a cover only. Since most operations were generally reported to cease at temperature below -40°F., a low temperature limit of -30°F. for firing and -40°F. for transport did not appear to be overly restrictive. This

[83] ARGMA/OML TR 1B1R, 15 Sep 59, pp. 58-60. RSIC.

Table 4

U

(~~C~~) COMPARISON SUMMARY, M31 AND XM50 ROCKETS (U)

ITEM	M31 RKT	XM50 RKT	REMARKS
1. ACCURACY-20,000 METERS RANGE			
PRESENT ENVIRONMENT SPECIAL HEAD, M386 LNCHR			
RANGE PE (TIME FUZING-METERS)	148	107	
ALTITUDE PE (TIME FUZING-METERS)	173	106	
DEFLECTION PE (TIME OR ALTITUDE FUZING-MILS)	295	180	
RANGE PE (ALTITUDE FUZING-METERS)	285	325	
2. RANGE (METERS)			
MINIMUM-(TIME FUZING)	5500	6100	8 SECONDS ARMING TIME
MAXIMUM-(ALTITUDE FUZING)	25,900	39,000	
3. TEMPERATURE LIMITS			
STORAGE (°F)	-10 TO 120	-65 TO +120*	*10 DAYS AT +130°F
HANDLING (°F)	0 TO 120	-40 TO +120	10 DAYS AT +130°F
FIRING	0 TO 120	-30 TO +120	
4. PHYSICAL CHARACTERISTICS			
WEIGHT (SPECIAL HEAD) (POUNDS)	5530	4360	MOTOR WEIGHS 3960 VS 2900
LENGTH (INCHES)	327	298	
DIAMETER (INCHES)	30	30	
FIN SPAN (INCHES)	102	56	
PAYLOAD WEIGHT (MAXIMUM)	1500	1500	
AIRBORNE RESTRAINT	NO	YES	
QUICK ARM IGNITER	NO	YES	
5. OPERATIONAL SUITABILITY			
ASSEMBLY TIME	LONGER	SHORTER	
CHECK OUT TIME	LONGER	SHORTER	
HEATING BLANKETS REQUIRED			
SHIPMENT AND STORAGE	YES	NO	
FIRING	YES	NO*	*TEMPERATURES BELOW -30°F
TACTICAL CRATES	3	2	
TYPE HELICOPTER	H-37	H-34	
6. EFFECTIVENESS			NOTE: BASED ON 90%
FRACTION OF TOTAL TARGET COMPLEX DEFEATED	.52	.61	PROBABILITY OF 50% COVERAGE
FRACTION OF ZONE II TARGETS DEFEATED	.50	.75	TARGET COMPLEX FROM ACSI
FRACTION OF ZONE III TARGETS DEFEATED	0	.05	PROJECT NO. A-1920
FRACTION OF ZONE II & III TARGETS DEFEATED	.36	.55	CURRENT ENVIRONMENT

Source: ARGMA/OML Technical Report 1B1R, sub: HJ Project TW-200 - Evaluation of Rocket, 762-mm, XM50, dated 15 September 1959.

conclusion, however, was subject to much debate.[84]

(U) Based on a preliminary evaluation of R&D Test data, the Ordnance Missile Laboratories released 12 XM-50 rockets of the tactical configuration for user test in July. A final analysis of R&D tests completed as of early July 1959 was later published in a statement of accuracy on 15 September 1959.[85]

(U) Phase I Service Test

(U) The Artillery Board at Fort Bliss, Texas, test fired 12 R&D rockets on 15-16 July 1959 as part of the integrated R&D-engineer-user program. The rockets were launched in two-round volleys, three pairs at a quadrant elevation of 22.5° and three at 45.0°. The test report, submitted in early August 1959, indicated that the XM-50 rocket offered significant operational advantages over the M31 rocket with respect to range, weight, resistance to environment, and rate of fire; however, the test results showed little improvement in accuracy performance.

(U) In general, the XM-50 rocket was found to be biased to the left of the firing line by about 10 mils. The mean deflection probable error of about 16 mils around the center of impact indicated no significant improvement over the M31 rocket. The mean range probable error for ground impact was about 300 meters at a 26,000-meter range—essentially the same as that for the M31 rocket. The Artillery Board concluded that the sample of six pairs of rockets was too small to be conclusive, and that these firing results alone did not warrant an unqualified statement of acceptance of the XM-50 rocket. However, in view of the R&D flight test results and the operational advantages offered by the improved

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[84] Tvl Rept, John A. Robins, 26 Mar 59, Visit to Ft Richardson & Ft Greely, Alaska, 27 Feb - 5 Mar 59. HJ R&D Case Files, Box 13-562, RHA AMSC.

[85] ARGMA/OML TR 1B1R, 15 Sep 59, p. 6. RSIC.

system, the Board recommended that the CONARC concur in the industrial release of the XM-50 rocket for limited production.[86]

U
(~~C~~) Release for Limited Production (U)

U
(~~C~~) The classification of the XM-50 rocket (less warhead) as Limited Production (LP) Type was concurred in by the CONARC on 10 August 1959 and by the Army Chief of Research & Development 2 days later.[87] In mid-September 1959, the Secretary of the Army approved the release for FY-1960 procurement of 1,044 rounds (1,020 industrial plus 24 R&D). This brought the total XM-50 procurement since FY 1958 to 1,378 rounds, 358 of which were R&D models. Components of the initial industrial model are shown in the exploded view that follows. The XM-3 thermal insulation blanket, originally intended for use with the XM-50 and M31 rockets, was not procured for troop issue. Instead, pertinent sections of the M2 (XM-2E2) electric blanket would be issued when required for the XM-50 rocket.

(U) Future plans called for the continuation of XM-50 flight tests in preparation of firing tables for the M386, XM-33, and M289 launchers. Initial industrial deliveries of the XM-50 rocket were scheduled to begin in November 1960. The Ordnance Support Readiness date for the XM-50 rocket with M386 launcher was set for the third quarter of FY 1961.[88]

U
(~~C~~) In the meantime, the Secretary of the Army approved the classification of the T2044E1 HE warhead as LP type on 6 August 1959. This interchangeable head was later phased into production to replace the

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[86](1) TT 5-1208A, Pres, Army Arty Bd, Ft Bliss, Tex, to CG, CONARC, 6 Aug 59. (2) Also see Ltr, DAC to CG, AOMC, 3 Aug 59, sub: Contr DA-04-495-ORD-693 - HJ XM50 Rkt User Test Prog. Both in HJ R&D Case Files, Box 13-562, RHA AMSC.

[87](1) TT 236793, CG, CONARC, to CRD, DA, 10 Aug 59. (2) DF, CRD to CofOrd, 12 Aug 59, sub: XM50 Rkt. File same.

[88]OTCM 37178, 17 Sep 59. RSIC.

old M6 (T2043E1) warhead which was compatible only with the M31 series rocket. Of the 660 M6 heads programmed for FY 1959, 180 were converted to the T2044E1 type. Industrial procurement authorized for the latter warhead in FY 1960 totaled 795 units.[89]

U (~~S~~) In mid-December 1959, the interchangeable XM-38 flash-smoke practice warhead was classified as LP type for FY 1960 industrial procurement of 116 units, 18 of which were earmarked for engineer-user tests. Fifteen R&D models were procured in FY 1959 for use in the R&D test program. The estimated cost of the first 116 production units without container was $364,820 ($3,145 each).[90]

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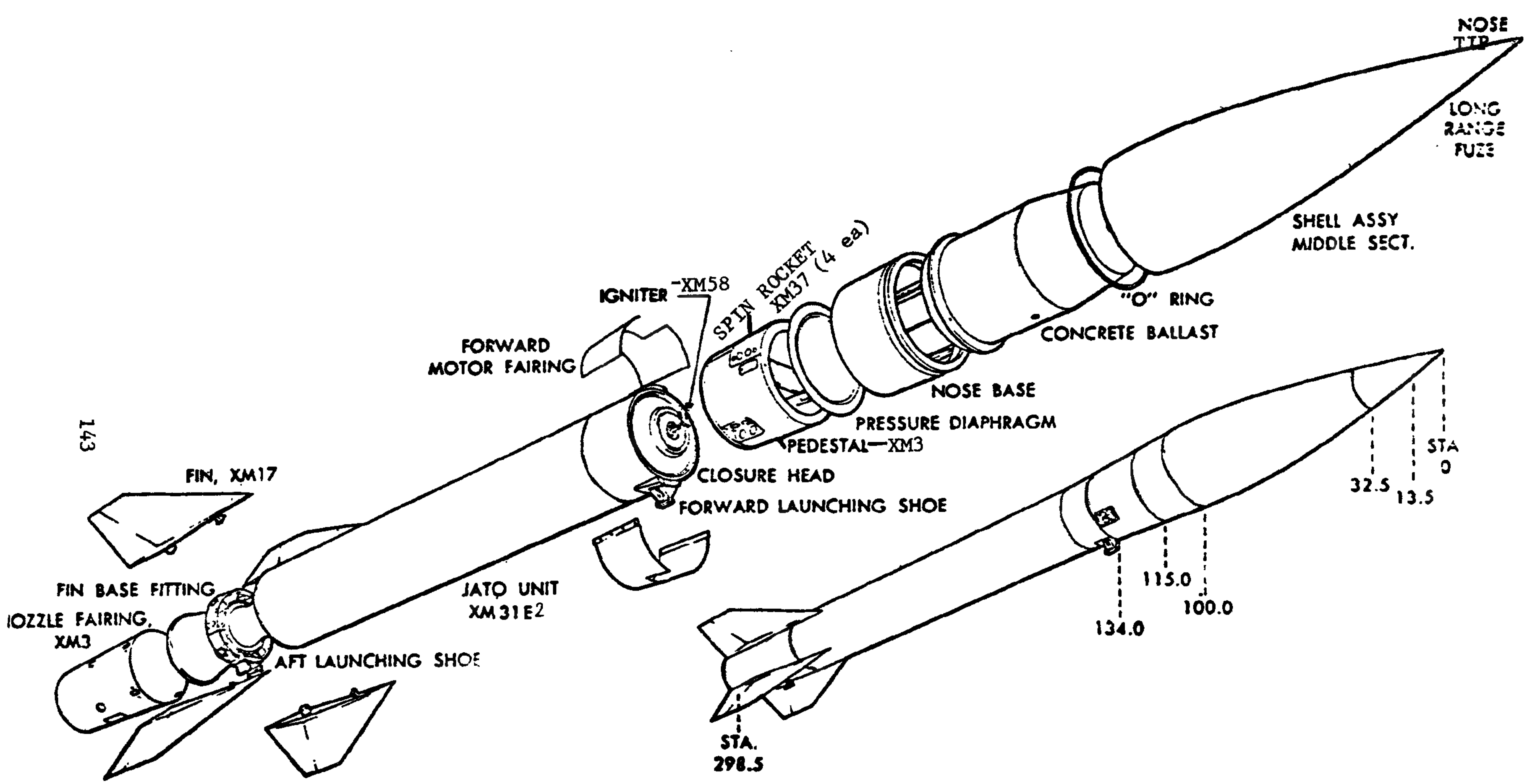
[89] OTCM's 37150, 6 Aug 59; 37339, 28 Jan 60. RSIC.

[90] OTCM 37264, 17 Dec 59. RSIC.



EXPLODED VIEW OF **ROCKET, 762MM-XM50 (September 1959)**

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CHAPTER V

([redacted]) ROCKET PROCUREMENT AND PRODUCTION (U)

(U) Industrial participation in the XM-50 rocket program actually began with the conditional release of R&D drawings in October 1958 for FY-1959 procurement of 204 R&D rounds. At that time, it will be recalled, the improved rocket was yet in the very early stages of development, less than 10 flight tests having been conducted with marginal success. Nevertheless, early industrial participation was necessary to anticipate and alleviate potential bottlenecks in preparation for the initial industrial release in the fall of 1959. The evolution of the XM-50 rocket through the limited production release in September 1959 has been traced. It now remains to examine the industrial phase of the XM-50 program from its inception in the fall of 1958.

([redacted]) Production and Support Risks (U)

(U) In any telescoped program, where a complex missile system is pressed into production before completion of the R&D phase, Army planners must consider the elements of risk involved and be prepared to pay the price, not only in dollars but also in compromised quality of the initial product. The pitfalls normally encountered in such a compressed effort are as numerous as they are expensive. As a general rule, considerable duplication of effort can be expected in such areas as engineering, component design, tooling, and documentation. Until the R&D design is completed and proved, spare parts requirements cannot be firmly established. Frequent design changes generate Engineering Change Orders and result in spiraling hardware and contract administration costs.

(U) One of the key advantages of the telescoped R&D-industrial

program is that it provides preparedness insurance. Early industrial entry into a program not only accelerates development, but also establishes a production facility and necessary manufacturing know-how that can be called upon when required for quantity production of a military weapon. Hence, if there is adequate assurance that a proposed missile system can be developed into a tactically useful weapon and produced in quantity at reasonable unit cost, the basic Army policy is to "crash" the program regardless of the attendant disadvantages. The underlying philosophy in support of this policy can best be summed up in the words of Lt. Gen. Carter B. Magruder. As the Deputy Chief of Staff for Logistics in April 1958, he wrote:

> In a period of great scientific progress such as the one in which we live, wars may well be won by major advances in equipment and weapons not equalled by the enemy. It is very difficult to keep any major advance entirely secret. Accordingly, advantages over the enemy are of relatively short duration and it is therefore essential to maintain progress by improving our equipment and weapons faster than he can improve his. Wars are not won by weapons on the drawing board or even weapons which have been fully developed but not produced in adequate quantity. It is therefore of critical importance that . . . measures [be determined and implemented] that will reduce the time required in the development of new items from conception to availability in quantity in the hands of troops.[1]

(U) Such was the philosophy applied in the XM-50 rocket program. The compressing of R&D-industrial schedules into a parallel effort necessarily involved certain calculated risks, but the short-cut found justification in the urgent need for an early operational capability. By taking these risks, the program planners estimated that they could shave from 1 1/2 to 3 years from the completion date. Otherwise, the rocket system submitted for standardization would probably be obsolete.

(~~C~~ U) At the time of the conditional R&D release in the fall of 1958, the XM-31 motor had already undergone one major modification to meet

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[1]Memo to Maj Gen J. H. Hinrichs, CofOrd, 14 Apr 58, sub: Ordnance Objectives.

stringent weight and balance requirements of the XM-50 rocket. The 204 R&D rounds placed on order in late 1958 included the lightweight XM-31E1 motor and the XM-37 spin-buck jato. Early in 1959—after 10 months and more than 30 R&D rockets had been spent in dynamic tests—the developer found that the spin-buck technique was not acceptable from an accuracy standpoint. The development program was therefore reoriented to consider a conventional straight spin system similar to that used on the M31 rocket. The results of 10 flight tests, in April and May 1959, indicated that the straight spin system had corrected the problem of deflection error, but serious range problems were observed. To correct the latter problem, the XM-31E1 motor propellant was changed to include an inert sliver, and XM-50 firings with the modified XM-31E2 motor were resumed in early June 1959. This change resulted in a direct loss of more than 30 rocket motor grains and consumed substantial time and funds.

(U) The procurement and fabrication of long leadtime items in advance of anticipated tests had definitely served to expedite the development program; but some of the components required considerable modification and retrofit, and some were even discarded as scrap. To curb this loss in future procurements, the ARGMA instituted three major safeguards: (1) detailed design requirements would be prepared for each major item; (2) each item would be subjected to a nonfiring design proof test to determine if the basic requirements had been met; and (3) primary data from the first dynamic flight tests would be closely evaluated to determine the adequacy of major components.

(U) In the latter connection, hardware for engineer-service tests had been contracted for and produced before the results of development tests had been fully analyzed. Consequently, the test agencies received a modified development prototype which did not incorporate all the design changes specified by the R&D program. Moreover, some of the items delivered for engineer-service test differed significantly from the design released for production. Nevertheless, these and other

risks had to be taken to expedite delivery of tactical hardware.[2]

U
(~~C~~) Production Concepts and Schedules (U)

(U) Ordnance Corps Order 16-58 delegated to the Army Ordnance Missile Command overall weapon system responsibility, including authority for funding and program control of all system components except the chemical warhead and certain nuclear training devices. The ARGMA, in turn was delegated the responsibility for weapon system management. Other Government agencies and contractors participating in the industrial program are shown in Chart 6.[3]

U
(~~C~~) Initial production quantities were derived from the 5-year Materiel Program draft of February 1960 and revised to 1 March 1960. (Prior-year production was for the M31 series rocket.) The ARGMA established an initial production rate of 49 rounds per month, with plans for expansion to 188 rounds per month by FY 1962.[4]

(U) To facilitate an orderly and rapid transition from R&D production to industrial production, the M31 rocket contractors and production facilities were employed for the XM-50 rocket. Production facilities and special tooling provided for the two systems through FY 1959 were valued at $11,332,000. Included were facilities for XM-50 pre-production engineering at the Emerson Electric Company, for production engineering on the XM-33 launcher at the Watertown Arsenal, for Honest John assembly and checkout at the WSMR, and for special warhead projects at the Twin Cities and Joliet Arsenals. Additional facilities required for the improved Honest John amounted to $6,633,500.[5]

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[2]HJ Msl Sys Plan, ARGMA MSP-11, 1 Jun 60, pp. 2-3A.

[3]See p. 94.

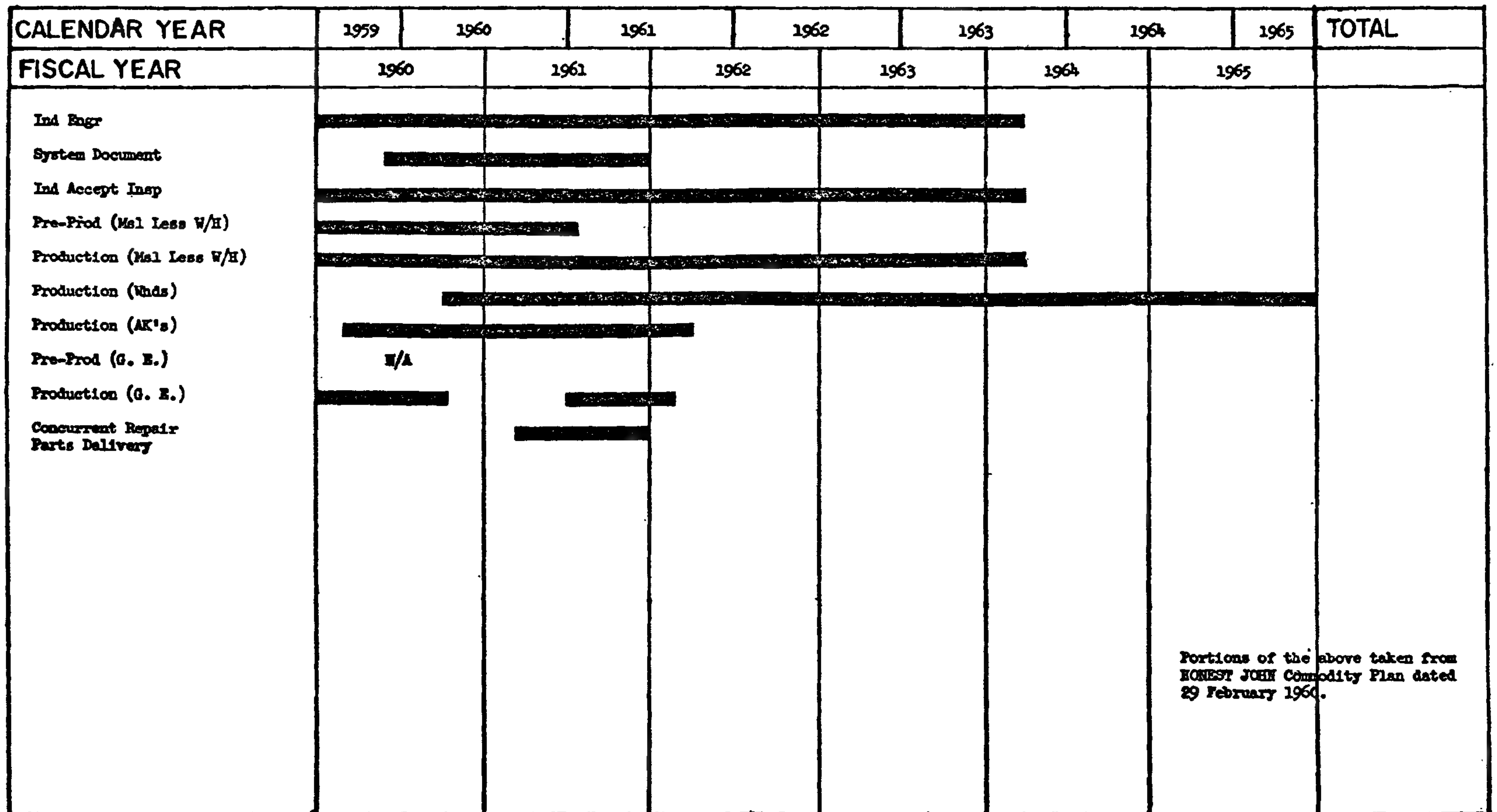
[4]HJ Msl Sys Plan, 1 Jun 60, pp. 3A, 3C, 4C, 1E. (2) Industrial phasing schedules for system components are depicted in Chart 7.

[5]HJ Msl Sys Plan, 1 Jun 60, pp. 2A, 2E, 20E, 21E.

CHART 7

INDUSTRIAL PHASING

IMPROVED HONEST JOHN (762MM) ROCKET SYSTEM



ARGMA Form 28, 1 June 58

(U) Industrial Engineering (U)

(U) The initial production model of the XM-50 rocket consisted of two major components: a tactical warhead and the XM-66 motor assembly. The latter was made up of three major parts: the XM-3 pedestal assembly (containing four XM-37 spin rockets, special batteries, and electric circuit), the XM-31E2 motor, and four XM-17E1 stabilizing fins.[6] The tactical warheads initially procured for the XM-50 rocket were the T2044E1 HE head and the XM-38 flash-smoke practice head. The XM-86 adaption kit was compatible with both the XM-50 and M31 series rockets.[7]

(U) The ARGMA assigned the engineering of the XM-66 motor assembly to the Picatinny Arsenal. Engineering effort to be performed was authorized and controlled by a scope of work issued by the ARGMA. Documentation was processed in accordance with appropriate engineering change order procedures.

(U) Industrial procurement of the XM-50 rocket (less warhead) was accomplished in two increments. The first-increment production was procured from R&D documentation and R&D specifications rewritten by the Picatinny Arsenal to include quality assurance provisions. Second-increment procurement was on the basis of industrial documentation prepared by the Emerson Electric Company, as revised and approved by the Picatinny Arsenal and the ARGMA. The procurement of parts was similar to that used for the first increment; however, there were certain deviations because of the different arrangement of assemblies in some cases.[8]

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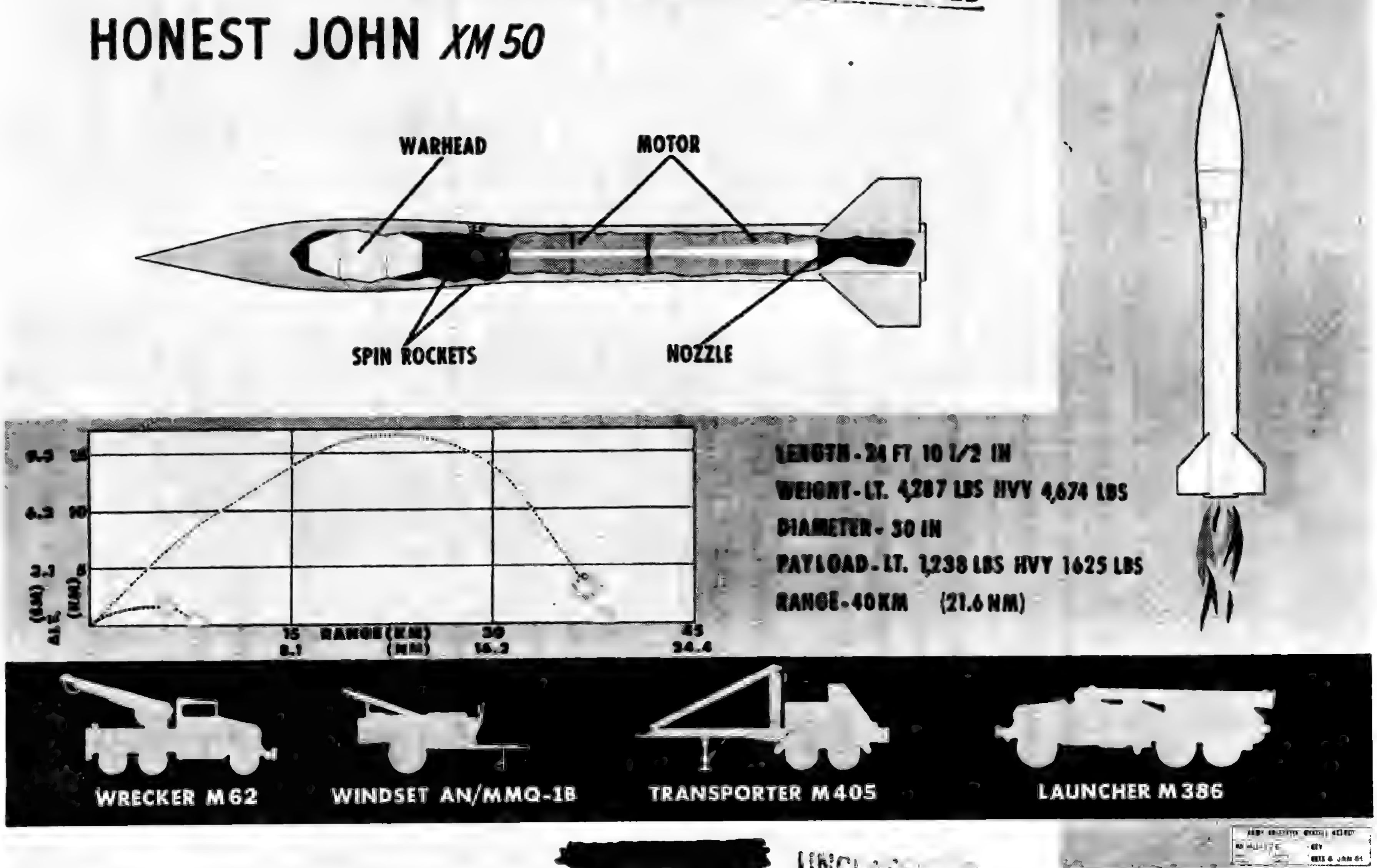
[6] _See_ exploded view of rocket components, p. 143.

[7] HJ Msl Sys Plan, 1 Jun 60, pp. 22D, 1E.

[8] _Ibid._, pp. 2E, 22E, 23E.

[redacted] UNCLASSIFIED



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(U) Pre-Standardization Production, FY 1960-63 (U)

(U) As a general rule, a weapon system developed under telescoped programming is first released for limited production (LP) using R&D documentation to work out engineering "bugs" in the design before standardization. In most cases, the R&D drawings are purified by the end of this first year and final industrial documentation becomes available for volume procurement of the weapon system as a standard military item. If the weapon system still fails to meet acceptable military standards after the first year, the LP restriction must be renewed for as many years as necessary to correct outstanding deficiencies.

(U) The XM-50 rocket fell in the latter category. It was released as LP type in September 1959, with first-year (FY-1960) procurement of 1,020 units (less warhead). The Army General Staff later increased the LP quantity from 1,020 to 2,000, to cover additional FY-1960 orders anticipated from the U. S. Marine Corps and the MAP.[9] Warhead procurement during that fiscal year included 116 XM-38 practice warheads and 795 T2044E1 heads.[10] Because of continuing technical problems with the XM-31 series motor, the XM-50 rocket remained in the LP category for the next 3 years. The limited production quantities were periodically increased during that period to satisfy needs of the integrated test program and to meet later service requirements.

(U) Integrated Test Program (U)

(U) Test firings of the XM-50 rocket were continued throughout the pre-standardization period to isolate and correct design deficiencies and to obtain range table data for the three launchers. The agencies

[9] OTCM's 37178, 17 Sep 59; 37439, 26 May 60. RSIC.

[10] OTCM's 37150, 6 Aug 59; 37264, 17 Dec 59. RSIC.

[redacted]

participating in the combined test program at the WSMR were the ARGMA, the Army Chemical Center, the Douglas Aircraft Company, the Ballistic Research Laboratories, the Picatinny Arsenal, and the CONARC. The engineer-user program reflected the R&D input and included all of the user requirements in the XM-50 integrated test program to the maximum extent possible.[11]

(U) All of the XM-50 flight test rockets were given a consecutive round number and a three-letter suffix denoting the test phase, the type warhead, and the type launcher, in that order. The code letters used in these respective categories were as follows:

Test Phase	Type Warhead	Type Launcher
R - R&D	O - Light Concrete Ballast[a]	L - M386
E - Engineer	D - Heavy Concrete Ballast[b]	H - XM-33
A - Quality Assurance	G - E19R2 Chemical	X - M289
P - Production	M - T2C44 HE	
U - User	P - XM-38 Practice	
	S - Special	
	B - T39	
	A - Over-Acceleration	

[a]Simulating the 1,000-lb. XM-27 head.

[b]Simulating the conventional, 1,500-lb. head.

For example, E38-ROL denoted an R&D test round (R), carrying a lightweight concrete ballast warhead (O), and fired from the M386 launcher (L). The prefix "E" was applied to all rounds equipped with the straight spin system, beginning with Round E1-ROL fired on 25 March 1959. Thereafter, all XM-50 rounds were numbered consecutively except the special test rounds such as the Slim Johns.

(U) Flight tests of the XM-50 rocket were resumed with the firing of Round E38-ROL on 22 July 1959, several weeks after completion of the special test series for preparation of the accuracy statement. By mid-December 1962, 389 additional XM-50 rounds had been test fired in all

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[11](1) HJ Msl Sys Plan, 1 Jun 60, pp. 36-38D. (2) Ltr, CG, AOMC, to Chf, USAAA, 23 Oct 63, sub: Testing the Improved HJ Rkt Sys.

A pair of XM-50 rockets mounted on M386 launchers at WSMR, 15 November 1962

phases of the program. This brought the number of XM-50 rounds expended in the overall improvement program to a total of 474 (see Table 5).

(U) Following the standardization of the M50 rocket in December 1962, the flight test program consisted mainly of quality assurance and engineer firings. During the 18-month period from January 1963 to mid-June 1964, there were only 56 M50 firings at the WSMR—33 quality assurance, 13 engineer, and 10 R&D. The firing plan for the succeeding 18 months, through CY 1965, called for 16 quality assurance firings.[12] These 72 flight tests would bring the total M50 rounds expended to 546—286 R&D, 114 engineer, 96 quality assurance, 12 production, and 38 user. As of October 1963, the estimated cost of conducting Honest John quality assurance tests at the WSMR was $10,500 per round.[13]

U (~~Ø~~) Modification of the XM-31E2 Motor (U)

U (~~Ø~~) Design deficiencies in the XM-31E2 motor (with inert sliver) were first observed early in December 1959, during static tests at -40°F. to +130°F. An examination of test data disclosed a significant loss of resonance suppressor weight, because of inadequate insulating material. The spacers between the lightening holes had burned out midway between the spreaders, weakening the suppressor to the point of failure. To allow time for correction of this deficiency, the Ordnance Missile Laboratories rescheduled the December flight tests for early 1960 and delayed the released for initial engineer tests. Also hindering the development program at this point was the lack of FY-1960 funds.[14]

(U) The design engineers resolved the suppressor problem, in

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[12] Chart No. HJ-172, 12 Jun 64, sub: HJ Rkt, M50, Firing Plan.

[13] TT, CG, WSMR, to CG, MICOM, 31 Oct 63. HJ/LJ Cmdty Ofc Files.

[14] (1) HJ Prog Rept, Dec 59, pp. 4-5. (2) DF, Dir, OML, to Chf, R&D Div, 9 Dec 59, sub: Ord Proj TW-200 - Recm Release of the XM-50 Rkt for Engr Test. HJ R&D Case Files, Box 13-563, RHA AMSC. (3) For details on the FY-1960 funding problem, see above, pp. 80-85.

December, by bringing the insulation thickness up to specification. To provide added confidence in future deliveries, they eliminated the lightening holes aft of the center spreader. This change was expected to result in a weight increase of 6 pounds; however, the hollow propellant sliver then under development offered a potential weight reduction of some 26 pounds.[15] As will be noted below, the hollow sliver proved unsuccessful and all motor grains so modified wound up in the scrap heap.

(U) Development flight tests were resumed in January 1960, and the last 10 flights for the M386 range table were completed shortly thereafter. The XM-50 rocket was then released in mid-March 1960 for engineer tests to evaluate accuracy and reliability. These and other tests continued without difficulty until 12 July 1960, when the WSMR reported a flight malfunction in Round E192-ROX. This particular round, temperature-conditioned at 120°F., malfunctioned in flight about 2.01 seconds after ignition. An examination showed that the resonance suppressor had separated from the grain immobilizer and blocked the nozzle, causing chamber rupture. This led to a modification of the XM-31E2 motor which became the XM-31E3. In the latter model, the resonance suppressor was centered and attached to the head closure (instead of the grain immobilizer aft plate), the nozzle closure was made removable, and the immobilizer aft plate was insulated.[16]

(U) In August 1960, the test crew at White Sands fired the first two XM-50 rounds with the new XM-31E3 motor, one having a hollow inert sliver and the other a solid sliver. Both rounds were temperature conditioned at 120°F. and fired at a quadrant elevation of 22.5°. The round with the hollow sliver (E193-ROL) malfunctioned in flight, again because of chamber rupture about 2.3 seconds after ignition. Inspection

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[15] HJ Prog Rept, Dec 59, pp. 4, 7.

[16] Dev Prog Rept, Jul 61, Hercules Powder Co, ABL, 17 Aug 60, pp. 1-4. HJ R&D Case Files, Box 13-562, RHA AMSC.

Table 5—Summary of XM-50 Flight Tests
17 June 1958 — 14 December 1962

TEST PHASE	TYPE WARHEAD									TYPE LAUNCHER			
	Ltwt Blst (O)	Hv Blst (D)	E19R2 Cml (G)	T2044 HE (M)	XM38 Prac (P)	Spec (S)	T39 (B)	O/A (A)	TOTAL	M386 (L)	XM-33 (H)	M289 (X)	TOTAL
(R) Rsch & Dev	192[a]	12	15	49	7			1	276	187	44	45	276
(E) Engineer	21	8		17	29	25	1		101	46	40	15	101
(A) Qual Assur					47				47	47			47
(P) Production					12				12	12			12
(U) User	12[b]		6	8	6	6			38	32	6		38
TOTAL	225	20	21	74	101	31	1	1	474	324	90	60	474

Phase/Warhead/Launcher Combinations

R&D Rounds
- ROL - 130
- ROH - 34
- ROX - 28
- RDL - 12
- RGL - 4
- RGH - 5
- RGX - 6
- RML - 34
- RMH - 5
- RMX - 10
- RPL - 6
- RPX - 1
- RAL - 1
- Total: 276

Engineer Rounds
- EOL - 12
- EOH - 6
- EOX - 3
- EDL - 7
- EDH - 1
- EMH - 17
- EPL - 14
- EPH - 9
- EPX - 6
- ESL - 12
- ESH - 7
- ESX - 6
- EBL - 1
- Total: 101

Quality Assurance Rounds
- APL - 47

Production Rounds
- PPL - 12

User Rounds
- UOL - 12
- UGH - 6
- UML - 8
- UPL - 6
- USL - 6
- Total: 38

LEGEND:

Test Phase	Warhead	Launcher
R - Rsch & Dev	O - Ltwt Ballast	L - M386
E - Engineer	D - Heavy Ballast	H - M33
A - Quality Assurance	G - Chemical	X - M289
P - Production	M - High Explosive	
U - User	P - Practice	
	S - Special	
	B - T39	
	A - Over-Acceleration	

NOTES:

[a]Includes nine special Slim John test rounds.
[b]Phase I Service Test at Fort Bliss, Texas.

SOURCE: Compiled from Table VIII, Appendix A.

of the parts indicated that grain collapse had caused nozzle blockage, which, in turn, caused chamber rupture. The flight test of Round E194-ROL with the solid inert sliver was successful.[17] Motors with the hollow sliver were subsequently scrapped.

(U) The next eight rocket firings proceeded smoothly. But the ninth (Round E203-ROX) malfunctioned in the now familiar chain reaction: grain breakup, nozzle blockage, and chamber rupture. This round, fired on 28 September 1960, had been conditioned at 120°F. A preliminary investigation indicated that the high-temperature conditioning of the rocket motor may have reduced the propellant grain strength, already sensitive because of a higher thrust and flight load. The Army Ballistic Missile Agency* indefinitely suspended all firings at 77° and above, although this same motor design had undergone five successful flight tests after conditioning at 120°F.[18]

(U) After further study, the ABMA concluded that the three flight malfunctions had been associated with the upper firing temperature limit (120°F.). Accordingly, it scheduled the next 10 rounds for flight test in a temperature range of 98° to 103°F. The satisfactory completion of these tests would qualify the XM-31E3 motor for interim industrial release. The Hercules Powder Company reported, in October, that grain shear was probably the main cause of the third failure and perhaps contributed to the previous two failures. It recommended that the propellant grain design be changed to incorporate a heavy butt section inhibitor to provide "hard" obturation and thereby prevent recurrence

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*Commodity management responsibility for the Honest John and certain other systems was transferred from the ARGMA to the ABMA on 1 August 1960. See above, p. 9.

[17]Dev Prog Rept, Aug 60, Hercules Powder Co, ABL, 16 Sep 60, p. 3. File same. (Also see Table VIII, Appendix A.)

[18](1) DF, Chf, Review Br, Control Ofc, to Chf, Control Ofc, ABMA, 12 Oct 60, sub: HJ Prog Rept (Interim, Sep 60). (2) Dev Prog Rept, Sep 60, Hercules Powder Co, ABL, 4 Nov 60, p. 6. File same.

of the stilted condition contributing to the failure.[19]

U (~~C~~) Since considerable time would be required to incorporate this design change in the final production model (XM-31E4), the ABMA Industrial and R&D Divisions recommended that the high-temperature requirement for the Improved Honest John Rocket be temporarily waived to 100°F., and that the rocket be qualified at this lower firing temperature limit. The R&D Division further proposed to continue efforts to requalify the rocket at the higher firing temperature.[20]

U (~~C~~) To meet FY-1961 test and inventory objectives, the Army General Staff approved an increase in limited production quantities of the XM-50 rocket from 2,000 to 4,074 units. Additional procurement was also authorized for the XM-38 and T2044E1 warheads, production of the former being increased from 116 to 701 and the latter from 795 to 1,200.[21]

U (~~C~~) <u>Final Motor Qualification Program</u> (U)

U (~~C~~) In August 1960, the Radford Arsenal had begun a series of XM-31E3 static tests in the search for a satisfactory base propellant grain for the first production motor. Following preliminary tests of a new base grain lot, the Arsenal static-tested two motors at 130°F. and two at -40°F. Neither met ballistic requirements. It then prepared six additional grains with a wide range of nitroglycerine in the solvent, in an effort to bracket the ballistic requirements precisely. On 11 October 1960, the rocket motor having the highest nitroglycerine level blew up at ignition, causing about $3,500 damage to the firing bay. No one was injured in the blast, and other bays were available for continuing the

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[19] Dev Prog Rept, Oct 60, Hercules Powder Co, ABL, 13 Dec 60, pp. 3, 6. HJ R&D Case Files, Box 13-562, RHA AMSC.

[20] DF, HJ Wpn Sys Proj Off to Chf, ABMA Control Ofc, 8 Nov 60, sub: Current Status of HJ Prog. File same.

[21] OTCM's 37554, 29 Sep 60; 37743, 18 May 61. RSIC.

test program. The real cost was in the continued delay of industrial production deliveries, already 3 months behind schedule. Until an acceptable grain could be qualified, the slippage would continue on a month-by-month basis beginning 1 January 1961.[22]

U
(~~C~~) In view of the 3-month slippage in the XM-50 program, the AOMC considered several alternative courses of action to bridge the gap between depletion of inventory stocks of the M31 rocket (around January 1961) and availability of the improved XM-50 rocket in April 1961. The procurement of additional M31 rockets in place of the XM-50 was ruled out as too costly in both time and money. Metal parts production for the M31 rocket had already been completed and final M31 deliveries would be made in December 1960. New production of this rocket would require a leadtime of 11 months and start-up costs would be prohibitive. Two other alternatives considered were the substitution of another motor for the XM-31 series, and the substitution of OIO propellant (M31) for the ARP propellant (XM-50). Neither of these was feasible, the former because no other motor was available for use with the XM-50 rocket and the latter because a propellant change-out would require a complete development program. The only other alternative short of an expensive production lay-off was to obtain a temporary waiver on the high-temperature requirements, as previously recommended by the ABMA.

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(~~C~~) In late November 1960, the AOMC, with verbal concurrence of the CONARC, lowered the high-temperature limit from 120°F.* to 100°F. This

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*The MC's originally established for the Honest John system (OTCM 34490, 20 Nov 52) called for built-in characteristics to permit operation in an air temperature range from -25°F. to <u>+125°F</u>. Tests of the XM-50 rocket motor had been conducted at temperatures as high as +130°F., but with little success. Some documents cite this latter temperature as the military requirement; while others—as in the present case—cite the requirement as 120°F.

[22](1) DF, Chf, Review Br, to Chf, Control Ofc, 7 Oct 60, sub: HJ XM-50 Firing Repts. (2) DF, Chf, ABMA Control Ofc, to Chf, AOMC Control Ofc, 17 Oct 60, sub: Result of HJ Explosion at Radford Ars. (3) TT 44-10, Comdr, ABMA, to CofOrd, 25 Oct 60. HJ Files, Box 13-562, RHA AMSC.

interim measure would permit the propellant contractor to proceed with qualification of a base grain for industrial release of the XM-31E3 motor by December 1960, thus retaining the Ordnance readiness date of April 1961. Meanwhile, effort would be continued to requalify the XM-50 rocket for operation at 120°F. The waiving of high-temperature firing limits to 100°F. would have no effect on safety considerations if the specified temperature were not exceeded by the firing unit. (About 1,000 Honest John rounds had been fired by using unit personnel throughout the world, and none of them exceeded 96°F.) At the behest of the Chief of Ordnance, the AOMC suspended shipments of M31 rockets obligated to overseas commands and held these in depot stock to support annual service practice (ASP) firings and other commitments.[23]

U (~~C~~) In addition to continued difficulties in qualifying the new base grain lot for operation at high temperature, the Radford Arsenal also encountered a problem at the low-temperature extreme. On 2 December 1960, an XM-31E3 rocket motor, conditioned at -40°F., exploded shortly after ignition, again causing considerable damage to the firing bay. Preliminary R&D investigations indicated that the cause of the malfunction could be eliminated early enough to prevent further slippage in the (April 1961) readiness date.[24] Later in December 1960, the ABMA released the XM-31E3 motor for production, but the operating temperature limits of the rocket were still restricted to a range of -30°F. to +100°F.[25]

U (~~C~~) The XM-50 rocket delivery schedule for April 1961 could not be met because additional static tests were yet required to prove an acceptable loaded lot.[26] Initial industrial deliveries started in May 1961.

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[23] SS ORDAB-CH-9-60, ABMA Comdr to CG, AOMC, 21 Nov 60, sub: Alternative Courses of Action for Meeting HJ ASP Firing & Inv Objectives; and incl thereto, TT 11-11-60, CG, AOMC, to CofOrd, 25 Nov 60.

[24] DF, Act Chf, ABMA Control Ofc, to Chf, AOMC Control Ofc, 6 Dec 60, sub: Malfunction of HJ XM31E3 Rkt Mtr at Radford Ars on 2 Dec 60.

[25] HJ Prog Rept, Dec 60, p. 4.

[26] HJ Prog Rept, Apr 61, p. 4.

The first lots were shipped directly from the Radford Arsenal to the USAREUR and to the Blue Grass Ordnance Depot.[27]

(U) In September 1961, the Army General Staff authorized another increase in LP quantities to cover FY-1962 requirements. Procurement of the XM-50 rocket was increased from 4,074 to 5,337, and the XM-38 practice warhead from 701 to 1,253.[28]

(U) A year later, the improved Honest John rocket was still awaiting final approval as a standard military item, although design deficiencies in the system had been eliminated. Type classification action to standardize the rocket was expected in the second quarter of FY 1963, but that was not soon enough to maintain the necessary production flow. Therefore, the stopgap limited production program was again extended in August 1962 to cover FY-1963 requirements. This brought the total LP procurement of XM-50 rockets to 6,347 and the XM-38 practice warhead to 2,176.[29]

(U) Between June and October 1962, the Ballistic Research Laboratories conducted a 50-round test program at the WSMR to improve the range tables and to provide additional confidence in the new rocket motor. These flight tests were satisfactory in all respects. Aside from further study of the upper firing temperature limit, no further R&D effort on the rocket motor was contemplated. Development work continued, however, on certain warhead sections.[30]

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[27](1) HJ Prog Rept, May 61, p. 4. (2) TT, CG, AOMC, to CofOrd, 16 May 61.

[28]OTCM 37859, 21 Sep 61. RSIC.

[29]OTCM 38125, 13 Aug 62. RSIC.

[30]AMCTCM 364, 13 Dec 62. RSIC.

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(U) Standardization of the M50 Rocket (U)

(U) The Ordnance Technical Committee initiated type classification action on the improved Honest John rocket in October 1962, immediately upon completion of the 50-round test program. Two months later, in mid-December, the Army General Staff approved the reclassification of the rocket from LP type (XM-50) to Standard A type (M50). The standard M50 rocket consisted of one M66 (XM-66E2) rocket motor and any one of the following warhead sections: HE M144 (T2044); Atomic M27, M47, or M48; Practice M38; and the E19R2 Chemical warhead (still under development). The M66 rocket motor assembly—actually comprising the M50 rocket without warhead section—was composed of the following component parts:[31]

4 Fins, M17 (XM-17E1)
1 Rocket Motor, M31 (XM-31E4)
1 Igniter, Rocket Motor, M58 (XM-58E1)
4 Rocket (Spin) Motors, M37 (XM-37E3)
1 Pedestal, M3 (XM-3E2)
1 Fairing, Nozzle, Rocket, M3 (XM-3E1)

(U) M50 Rocket vs M31 Series (U)

(U) As of December 1962, the unit production cost of the M66 rocket motor (or M50 rocket less warhead) was $12,536, in contrast to a unit cost of $8,469 for the M31A2 rocket less warhead. Significant improvements of the M50 over the M31A2 rocket included a 45 percent increase in maximum range; a 25 percent reduction in rocket motor weight, giving a gross weight loss of about 20 percent; a 9 percent reduction in overall length (14 percent reduction in motor length); and a 46 percent decrease in overall fin span. Improvements in accuracy were as follows:[32]

Accuracy at 23,600 meters--	M31	M50
Range Probable Error (meters)......	218	145
Deflection Probable Error (meters).	460	200
Altitude Probable Error (meters)...	312	140

[31] Ibid.

[32] Ibid.

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[redacted]

(U) As indicated in Chart 8, there were two performance areas where the M50 rocket failed to surpass the M31 series: minimum range capability[33] and upper firing temperature limit. When the M50 rocket was standardized in December 1962, its upper firing temperature limit was still restricted to +100°F.—20 degrees less than that of the M31 series. At that time, the results of recent quality assurance tests were being evaluated to qualify the rocket for firing at +120°F. This investigation was expected to be completed and the restriction lifted "in the immediate future."[34] However, the program was beset with continuing technical difficulties, and the temperature restriction still had not been officially lifted as late as April 1965.[35]

(U) Change in Model Designation

(U) With the type classification of the XM-66E2 rocket motor as the M66, in December 1962, both the XM-66 and XM-66E2 motors carried the M66 model number, resulting in model designation and interchangeability problems. For example, the M58 (XM-58E1) igniter used with the M66 (XM-66E2) motor weighed about 11 pounds less than the XM-58 model used with the XM-66 motor, and could not be interchanged because of firing table data markings. Other components were interchangeable between the two rocket motors, but improvements in design were such as to require a new model designation. The M31 (XM-31E4) motor had a modified immobilizer assembly and a different method for attaching the resonance suppressor, but was interchangeable with the XM-31E3 model used with the XM-66 rocket motor assembly. The M37 (XM-37E3) spin rocket motor, though interchangeable with the XM-37E1, represented a new design using

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[33] See above, pp. 137-39.

[34] AMCTCM 364, 13 Dec 62. RSIC.

[35] The Subcommittee on Guided Missiles recommended that the firing temperature limits be increased to +120°F. in AMCTCM 2766, 31 August 1964, but this item was yet to be approved by the Army General Staff.

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CHART 8

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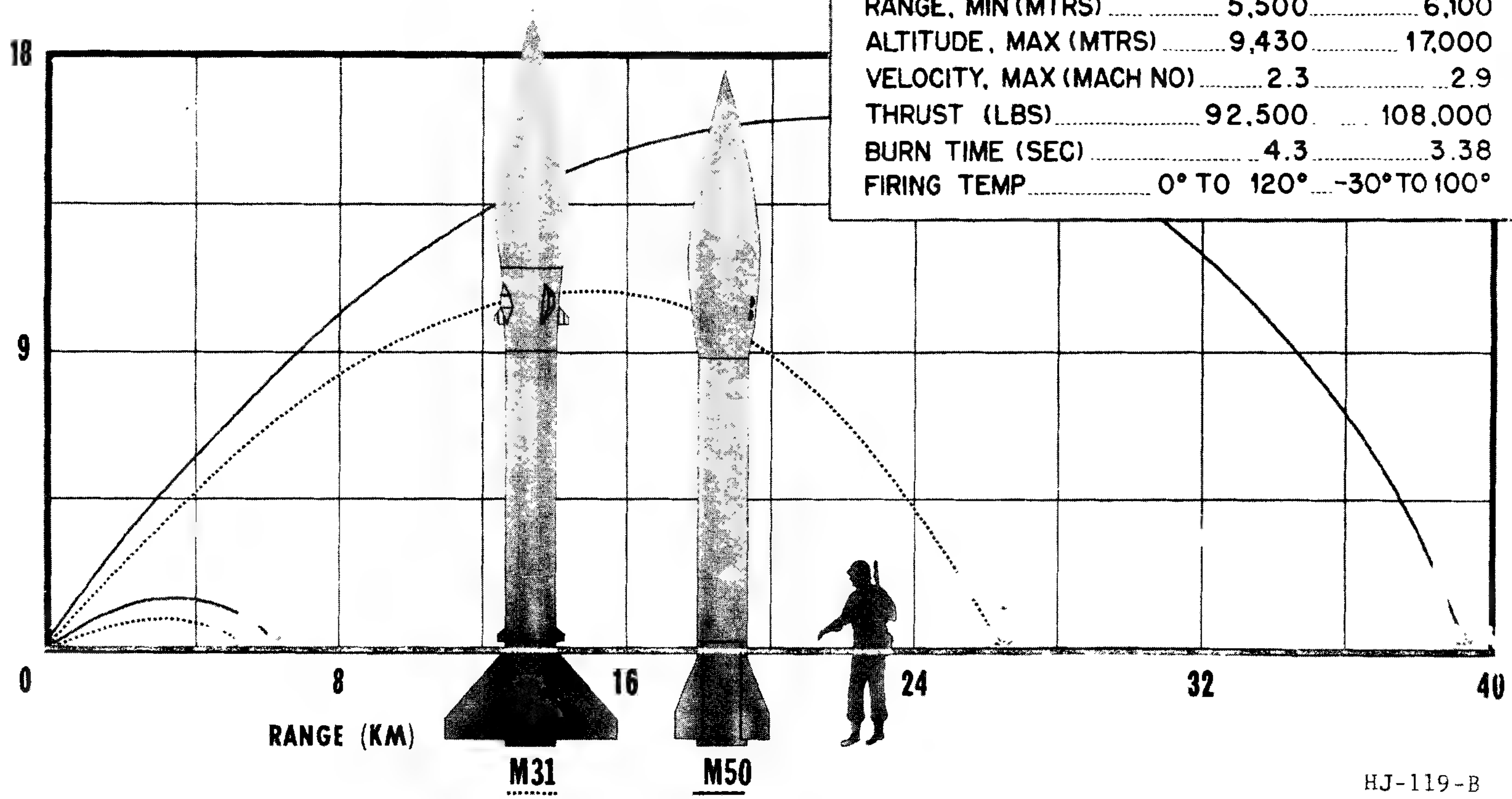
M31 vs M50

	M 31	M 50
LENGTH (IN)	327	298
BODY DIAMETER, MAX (IN)	30	30
FIN SPAN (IN)	104	56
WHD WT, ATOMIC (LBS)	1238	1238
RANGE, MAX (MTRS)	26,500	40,000
RANGE, MIN (MTRS)	5,500	6,100
ALTITUDE, MAX (MTRS)	9,430	17,000
VELOCITY, MAX (MACH NO)	2.3	2.9
THRUST (LBS)	92,500	108,000
BURN TIME (SEC)	4.3	3.38
FIRING TEMP	0° TO 120°	-30° TO 100°



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stick propellant instead of the cartridge double-base propellant. The M3 (XM-3E2) pedestal differed from the earlier model in that it incorporated a new swing-away electrical service panel. The M3 (XM-3E1) nozzle fairing incorporated a design refinement to preclude improper installation of the ignition switch for the spin motor. The M17 (XM-17E1) fin design was not changed.

(U) To distinguish between the initial industrial model (XM-66) and the production engineered model (XM-66E2), the latter was redesignated the M66A1 and retained as Standard A; the former was type classified as Standard B. Both rocket motor assemblies consisted of essentially the same major components with different model designations as shown below.[36]

M66A1 (XM-66E2) Standard A	M66 (XM-66) Standard B
Fin, M17 (XM-17E1)	Fin, XM-17E1
Rocket Motor, M31A1 (XM-31E4)	Rocket Motor, XM-31E3
Igniter, M58A1 (XM-58E1)	Igniter, XM-58
Rocket, Spin Motor, M37A1 (XM-37E3)	Rocket, Spin Motor, XM-37E1
Pedestal, M3A1 (XM-3E2)	Pedestal, XM-3
Fairing, Nozzle, M3A1 (XM-3E1)	Fairing, Nozzle, XM-3

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(~~C~~) Completion of Final Development Tasks (U)

(U) This type classification action, in May 1963, left only two development tasks incomplete. One of these involved the final design and standardization of the E19R2 chemical warhead; the other was concerned with the qualification test program to raise the upper firing temperature limit of the M66A1 and M66 rocket motors from +100° to +120°F.

(U) Development work on the E19R2 warhead was completed by the Chemical Corps early in 1964. The final design, compatible with both

[36] AMCTCM 955, 16 May 63. RSIC.

the M50 and M31 rockets, was standardized in mid-June 1964 as the M190 warhead section.[37]

U (~~C~~) Based on the results of a 57-round test sample, the motor developer concluded that the M66A1 and M66 rocket motors could be fired at +120°F., but at temperatures above 100° performance could be expected to decrease to 91 percent with an assurance of 90 percent. These findings, together with recommendations for appropriate changes in field and technical manuals, were incorporated in a report to the Army Materiel Command Technical Committee on 31 August 1964. As stated above, final approval of this action still had not been received as of April 1965.[38]

U (~~S~~) <u>Industrial Procurement - FY 1960-65</u> (U)

U (~~S~~) From the beginning of industrial procurement in FY 1960 through FY 1965, a total of 7,089 rockets (less warhead section) were produced and delivered—6,347 of the LP, XM-50 type (FY 1960-63) and 742 of the standard M50 model (FY 1964-65). Most of these, 4,503, went to U. S. Army units; the remaining 2,586 were for other customers, including the MAP.[39] Tactical warhead sections were procured in sufficient quantities to meet requirements for depot stock, field operations, annual service practice, customer orders, etc.

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[37](1) AMCTCM 2621, 17 Jun 64. RSIC. (2) <u>Also see</u> above, pp. 125-26.

[38]AMCTCM 2766, 31 Aug 64. HJ/LJ Cmdty Ofc File.

[39]AMP FY 1964-71 (draft, March 1965), Vol III, Part 1, p. 159. File same.

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CHAPTER VI

U (C) THE M386 LAUNCHER SYSTEM (U)

(U) In the course of the Honest John Improvement Program, the Rock Island Arsenal, in collaboration with the Redstone Arsenal and other Army agencies, designed and developed two improved launcher systems. One of these was the M386 self-propelled launcher, which represented a redesign of the standard M289 system; the other was the M33 helicopter-transportable launcher. All three of these launchers—the M289, M386, and M33—can be used interchangeably with both the M31 and M50 rockets.

(U) Preliminary Plans and Feasibility Studies (U)

(U) The events leading to the development of an improved truck-mounted launcher for the Honest John rocket date back to late 1954, shortly after initial overseas deployment of the basic weapon system. The tactical suitability of this system had been established early in 1954 in a series of weapon system tests conducted under simulated combat conditions. However, conflicting accuracy data contained in subsequent test reports created some uncertainty as to the performance that could be expected under actual combat conditions. Consequently, the Army General Staff, in October 1954, asked for a briefing on the tactical capabilities of the system and the extent of R&D effort required to bring performance within the limits specified in approved military characteristics. Late in November 1954, following a presentation given by the Douglas Aircraft Company, the DCSLOG directed the Chief of Ordnance to initiate a priority development program to improve the tactical capabilities of the Honest John system then in the field.[1]

[1](1) DF, DCSLOG to CofOrd, 20 Oct 54, sub: HJ Accuracy. (2) DF, same to same, 29 Nov 54, sub: HJ Imprv Prog. Both in ORDTU File, Sep - Dec 54, FRC. (3) Also see above, pp. 45-56.

(U) At the behest of the Chief of Ordnance, the Redstone Arsenal and the Douglas Aircraft Company prepared plans for possible improvements in the overall weapon system. These proposals were the subject of a conference at the Redstone Arsenal in mid-February 1955, and a report to the OCO in March. In addition to the primary aim of improving weapon system accuracy, the proposed development program included certain proven design changes for the rocket, launcher, and ancillary equipment to make the overall weapon system more suitable for field use.

(U) Specifically, it called for the development of a modified XM-289 launcher with a shorter launching rail of 14 or 15 feet; lighter weight; faster elevation, emplacement, and displacement; lower silhouette; standard ground clearance; and a standard M139C truck. To eliminate many of the repair problems and increase mobility, it was suggested that the M62 wrecker forward of the Battery Assembly Area (BAA) should be replaced by a general-purpose truck and a simple transfer device for moving the rocket from its transporter to the launcher. Other items of ground support equipment requiring improvement included the electric blanket, thermometer, circuit tester, and transfer beam. The cost of equipment modifications was estimated at $478,050, including $400,000 for launcher redesign and fabrication of two prototypes.[2]

(U) The proposed improvements in the XM-289 launcher system were approved by the Honest John Steering Committee during a meeting at the Rock Island Arsenal in mid-March, and by the Chief of Ordnance on 8 April 1955. The Rock Island Arsenal was authorized to begin design layouts for the new (XM-386) launcher based on a 14-foot guidance rail. It was also authorized to investigate the feasibility of developing an ammunition handling and loading vehicle, with a view toward eliminating both the XM-329 pole trailer and the M62 wrecker except as the latter might be used in the BAA for mating the special warhead to the basic

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[2] RSA Rept 3M51P, 11 Mar 55, sub: Prelim HJ Sys Imprv Prog, pp. 1, 5-7. RSIC.

vehicle. The Redstone Arsenal was to exercise technical supervision over the work assigned to the Rock Island Arsenal, and maintain constant liaison with that installation to insure prompt and effective solutions to any problems that might arise.[3]

(U) The Heavy Rocket Launcher Subcommittee met at the Ordnance Weapons Command (OWC) on 25-26 October 1955 and there established the final design for the XM-386 launcher. The new launcher was to have a 15-foot guidance rail, a faster elevating mechanism, a cross-leveling mechanism on the truck, and other design improvements. It would weigh about 33,700 pounds—some 8,000 pounds less than the XM-289 launcher. The Rock Island Arsenal was to begin fabrication of the two prototypes in January 1956, with delivery to the WSPG in August and September 1956, respectively. The Arsenal drew from Army stock two M139 truck chassis (5-ton 6 x 6), on which the two launchers were to be mounted.[4]

(U) During its October meeting, the launcher subcommittee decided to discontinue design work on the end-loader and concentrate on studies of a self-propelled transporter-loader instead of the towed-type. However, the Chief of Ordnance reversed this decision a few weeks later, holding that a self-propelled trailer would not satisfy the maneuverability needs of the improved system and, further, that it was unnecessary since an adequate self-propelled transporter was already in the field. Instead, he directed the Rock Island Arsenal to expedite the development of a towed, side-loading trailer for the new launcher, and to continue the feasibility study of an end-loading type trailer. The new side-loader—later to be known as the XM-405 handling unit—was to have many of the same basic features as the M329 trailer except for the addition of a jib crane for transferring the rocket to the launcher rail.

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[3](1) Min, HJ Steering Com Mtg at RIA, 16-17 Mar 55. (2) Ltr, OO/5C-7814, CofOrd to CG, RSA, 8 Apr 55, sub: HJ Imprv Prog - RSA Rept No. 3M51P dated 11 Mar 55. Both in ORDTU File, Jan - Apr 55, FRC.

[4]Monthly Prog Rept, Proj TU2-1029 HJ & Proj TU2-3008 Lchg & Hdlg Equip for HJ, Oct 55, n.p. ORDTU File, Sep - Dec 55, FRC.

This feature was intended to replace the M62 wrecker that was required with the XM-329 trailer and XM-289 launcher.[5]

(U) Because of financial problems, the rear-loading trailer was later dropped from the program after 95 percent of the design work had been completed. The XM-405 program continued through initial production and field deliveries. However, it became entangled in a maze of technical and administrative difficulties which ultimately led to a loss of user confidence in the unit and subsequent termination of production orders, along with a full-scale investigation by the General Accounting Office.[6]

(U) Early in November 1955, the test crew at the WSPG successfully demonstrated the feasibility of the 15-foot guidance rail. One M31A1 rocket was launched from an XM-386 mockup with necessary instrumentation to determine the interaction between the rocket and launcher rail. The results of this test corroborated the findings of earlier studies made by the Douglas Aircraft Company.[7]

(U) With the standardization of the M289 launcher in mid-December 1955, the Rock Island Arsenal was able to devote practically full time to the development of the XM-386 launcher and ancillary equipment.[8] The detailed project plan, published by the Redstone Arsenal later in December, called for completion of all work on the tactical XM-386

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[5](1) Ibid. (2) Monthly Prog Rept, Projs TU2-1029 & TU2-3008, Nov 55, n.p. File same. (3) Niel M. Johnson and Leonard C. Weston, Development and Production of Rocket Launchers at Rock Island Arsenal, 1945 - 1959 (2 vols, RIA, August 1962), II, 186-87.

[6]To give this controversial phase of the program a greater depth of treatment, the subject is dealt with in a separate chapter. See below, pp. 235ff.

[7](1) TT, CG, WSPG, to CofOrd, 8 Nov 55. (2) Ltr, CG, RSA, to CofOrd, 12 Dec 55, sub: Ord Proj TU2-1029, Proj Status. Both in ORDTU File, Sep - Dec 55, FRC.

[8](1) OTCM's 36012, 1 Dec 55; 36040, 15 Dec 55. RSIC. (2) Johnson and Weston, op. cit., II, 181.

launcher system by 1 August 1957.[9] The two R&D prototype launchers were to be delivered for testing at the WSPG in August and September 1956, as previously scheduled. At the end of December 1955, about 50 percent of the layout drawings had been completed, and fabrication of launcher components was about 5 percent complete, this work having been started several weeks ahead of the January 1956 target date.[10]

(U) Design and Development of Pilot Models (U)

(U) With fabrication work started ahead of schedule, the Rock Island Arsenal had hoped to step up the delivery of initial pilot models to the spring of 1956. However, design difficulties and higher priority work on the Littlejohn launcher delayed the delivery some 2 months beyond the original target dates of August and September. At the peak of development effort in the summer of 1956, the rate of expenditure on the project at Rock Island reached $12,000 per week.[11]

(U) Design difficulties in the launcher and support equipment were worked out in monthly meetings of the Honest John Steering Committee during the spring of 1956. In May, the launcher design was again reported as final, and in June, the Arsenal sent a scale model of the XM-386 to the OCO. At the end of June, engineering layout drawings on the launcher were 95 percent complete, 75 percent of the hardware had been fabricated, and assembly of the first model was under way.[12]

(U) In August 1956—the month originally set for delivery of the

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[9] RSA/OML Rept No. 433, 25 Dec 55, sub: Proj Plan for Dev of an Imprv HJ Sys, p. 20. For further details relating to this plan and subsequent changes thereto, see above, pp. 68-75.

[10] Johnson and Weston, op. cit., II, 187.

[11] Ibid., II, 187-89.

[12] (1) Ibid., II, 187. (2) Ltr, Comdr, RIA, to CG, OWC, 1 May 56, sub: HJ Imprv Prog, w/5 Incls. HJ R&D Case Files, Box 15-95, RHA. (3) Min HJ Steering Com Mtgs, Apr, May, Jun 56. ORDTU File, May-Aug 56, FRC.

first pilot model—the Arsenal encountered a last-minute delay in the assembly operation because of additional design deficiencies which had to be corrected. At the end of August, the engineering layout drawings had been completed, but assembly of the launcher and trailer (side-loader) was 25 percent short of completion. Further difficulties were then encountered in local tests, and the qualification test program at the WSPG was rescheduled for October 1956.[13]

(U) Qualification Test and Design Refinement (U)

(U) As originally planned, the XM-386 launcher was to be qualified with the XM-31E2 rocket—the modified M31 rocket with improved fin-spin system. However, the program was reoriented in May 1956 to provide for development of an entirely new rocket (the XM-50) with an improved motor. Since the XM-386 launcher was then nearing the test phase and was in fact about a year ahead of the new rocket, the Redstone Arsenal obtained approval of a plan to use standard M31 rockets in the launcher qualification test program.[14]

(U) The first prototype launcher arrived at the WSPG on 12 October 1956; the second pilot model followed in early November. Between 18 October and 21 June 1957, 33 standard M31 rockets were fired from these pilot models in the qualification test program.

(U) The first two firings from launcher #1, on 18 and 31 October, were generally successful, with only a few minor revisions necessary.[15]

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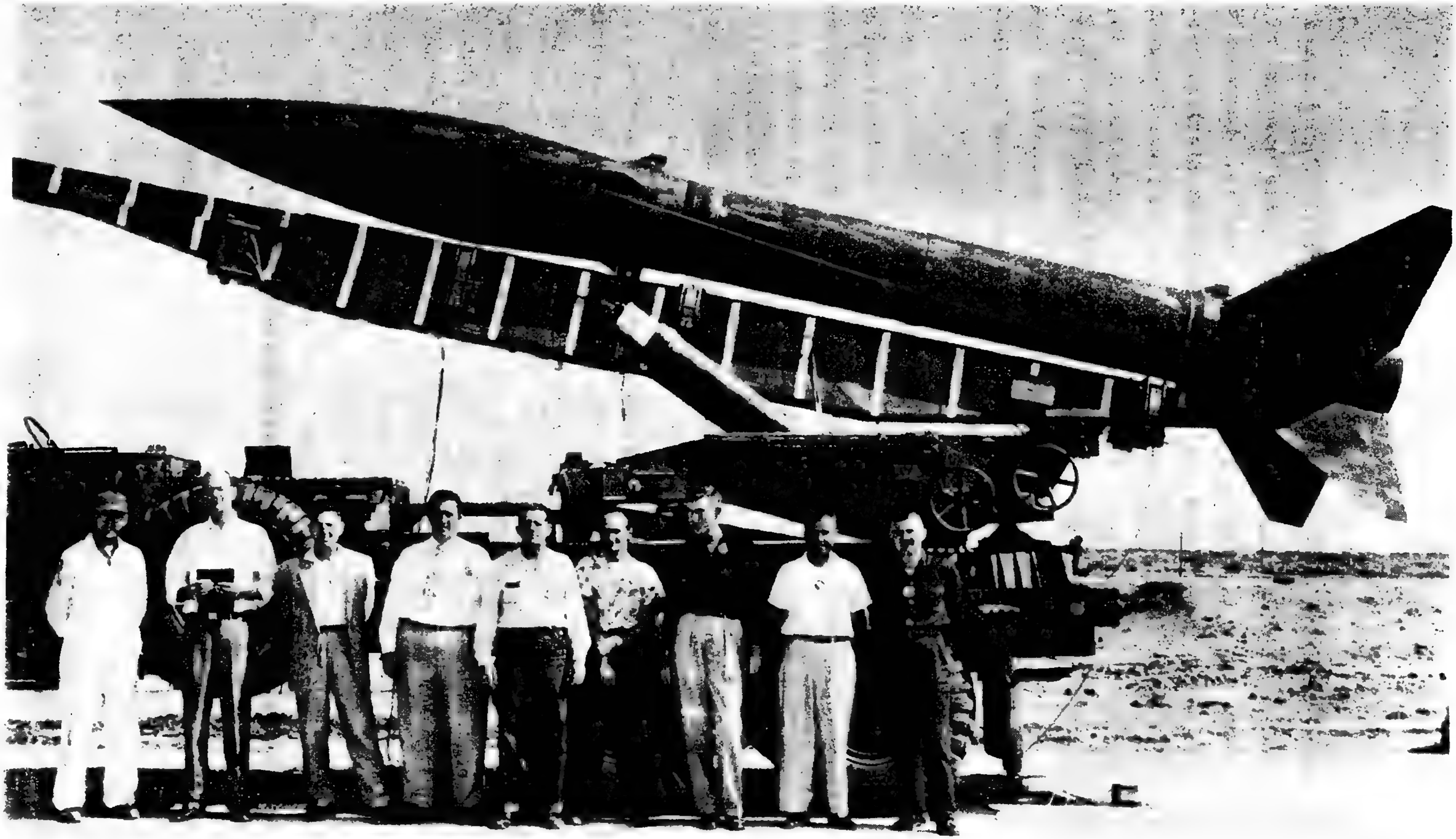
[13](1) Ltr, Comdr, RIA, to CG, OWC, 31 Aug 56, sub: HJ Imprv Prog. File same. (2) Johnson and Weston, op. cit., II, 189.

[14](1) Ltr, CG, RSA, to CofOrd, 18 Apr 56, sub: Ord Projs TU2-1029 & TU2-3008, HJ Imprv Prog. ORDTU File, Jan - Apr 56, FRC. (2) TT, OCO to CG, RSA, 14 May 56. ORDTU File, May - Aug 56, FRC. (3) Ltr, same to same, 4 Jun 56, sub: HJ Imprv Prog. File same. (4) Also see above, pp. 73-75.

[15](1) Johnson and Weston, op. cit., II, 189. (2) WSPG HJ Actv Rept, Oct 56, n.p. ORDTU File, Sep - Dec 56, FRC.



XM-386 Launcher-M31 Rocket with Members of the RSA Rocket Development Laboratories who Participated in the Qualification Test Program at the WSPG, 1956-57. Shown from left to right are: Mitchell Linney, Electronic Technician; John L. McDaniel, Deputy Chief, Test & Evaluation Laboratory; Larry Nicastro, Project Engineer; Jack Hendrix, Range Engineer; James R. Williams, General Foreman; Virgil Harwell, Technician; Jim Collins, Electronic Engineer; Dale Soulek, WSPG Liaison Engineer; and Ray Turner, Operational Test Engineer.

The next two firings, in November, revealed some interference between the rocket and the last 5 feet of the launching rail, the movement of the rocket along the rail causing a rebounding of the tip. Launcher #1 was then returned to Rock Island for the installation of blast deflectors to correct the deficiency. The flight tests scheduled for December were cancelled; but operational tests were conducted with launcher #2, the handling unit, circuit tester, and heating and tiedown kit. The results of the latter tests indicated that the equipment would be satisfactory with only minor modification. Cold-room tests at -40°F., in January 1957, were also successful.[16]

(U) The test crew at the WSPG received launcher #1 from Rock Island early in January 1957. In addition to the installation of blast deflectors, the Arsenal had made several other design refinements to prevent rocket-launcher interference and to improve performance in general. The results of two flight tests, in late January, indicated little success. It then appeared that the rail rebound was the cause of the interference, rather than the blast itself. The engineers at Rock Island thus initiated studies of a passive restraint system, using higher rocket shoes and a strut to stabilize the beam. In the meantime, both of the pilot models were returned to Rock Island for cold tests.[17]

(U) The Rock Island Arsenal later concluded that the higher rear launcher shoes would possibly correct the rail rebound problem, but a major redesign and new range tables would be necessary. The Redstone Arsenal advised the OCO, in mid-March 1957, that such redesign could be phased in with the XM-50 rocket development, but this would prevent immediate availability of the improved launcher. Since the XM-386 launcher did not contribute to improved system accuracy, it was not

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[16]WSPG HJ Actv Repts, Nov & Dec 56, Jan 57, n.p. ORDTU Files, Sep - Dec 56 & Jan - May 57, FRC.

[17](1) WSPG HJ Actv Rept, Jan 57, n.p. ORDTU File, Jan - May 57, FRC. (2) Johnson and Weston, op. cit., II, 190.

high in priority and so could be rescheduled without harm to the program. The Arsenal recommended that the modified XM-386 launcher be qualified with the XM-31E2 rocket (XM-50 mockup), with no additional rockets required beyond the number already planned.[18] The Chief of Ordnance agreed to this proposal with the understanding that it would not cause an additional delay in the release of the XM-386 launcher to the troops.[19]

(U) In response to the proposed program, the CONARC suggested the procurement of long leadtime items for the XM-386 launcher rather than the M289, since the XM-386 promised significant improvements to the overall system. It also suggested concurrent engineering-service tests of the XM-386 prototype to permit early changes to the production model.[20]

(U) The Redstone Arsenal reported, in late April 1957, that flight tests of the XM-31E2 rocket had been delayed and that this rocket was no longer in time phase with the XM-386 launcher. Therefore, qualification tests of the launcher with extended rear shoes had been resumed in early April using standard M31 rockets. The results of eight flight tests conducted through early May indicated that the rocket-rail interference problem had been solved.[21]

(U) Paired firings to establish range tables were begun later in May and continued through 21 June 1957. A preliminary analysis of these tests indicated that adequate accuracy had been maintained.[22] However, the CONARC reported that the lateral deflection accuracy was not acceptable. The Artillery Board advanced the opinion that the shortened

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[18]Ltr, CG, RSA, to CofOrd, 18 Mar 57, sub: Ord Proj TU2-1029 & TU2-3008, Dev of Imprv HJ Sys, w/7 incls. ORDTU File, Jan - May 57, FRC.

[19]DF, CofOrd to Chf, R&D Div, OCO, 21 Mar 57, sub: same. File same.

[20]Msg, ATDEV-1 39682, CG, CONARC, to CRD, DA, 1 Apr 57. ORDTU File, Jan - May 57, FRC.

[21](1) Ltr, CG, RSA, to CofOrd, 24 Apr 57, sub: Ord Proj TU2-1029 & TU2-3008, Dev of an Imprv HJ Sys. File same. (2) Also see Table III, Appendix A.

[22]Johnson and Weston, op. cit., II, 192.

guidance rail might very well cause this inaccuracy, since it was more susceptible to wind-caused movement than was the 30-foot M289 launcher rail. The user also noted other deficiencies in the XM-386 pilot models: instability of the carriage at higher elevations; poor bore sight arrangements; and inaccessibility of the rocket when loaded and elevated. To correct the listed deficiencies, 13 modifications would be required to both launchers and an additional 6 to launcher #2 only. The two R&D prototypes were returned to Rock Island for correction of the noted deficiencies.[23]

(U) Standardization of Launcher and Ancillary Equipment (U)

(U) The Commanding General, CONARC, in July 1957, recommended that the XM-386 launcher be type classified as standard when modified to correct deficiencies, and that the first production item be furnished to the Artillery Board for confirmatory evaluation as soon as possible. He also recommended that no further consideration be given to equipping any future missile commands with the M289 launcher, and that this item be type classified as Limited Standard. The CRD promptly approved these recommendations without reservation. In late July, he requested that the Chief of Ordnance take priority action to type classify the XM-386 launcher as standard so that procurement could be initiated with the least practicable delay.[24]

(U) At that time, the modifications specified by the user still had not been completed, and most of the ancillary equipment was yet to be approved for standardization. Nevertheless, it was essential that the

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[23] (1) TT ATDEV-1 43107, CG, CONARC, to CofOrd, 11 Jun 57. (2) Ltr, CG, OWC, to CofOrd, 27 Jun 57, sub: Lchr, 762MM Rkt, Trk-Mtd XM-386. Both in HJ R&D Case Files, Box 15-95, RHA AMSC.

[24] (1) TT ATDEV-1 44597, CG, CONARC, to DA, 13 Jul 57, & Suppl Ltr to CRD, DA, 23 Jul 57, sub: Type Clas of XM-386 Lchr (HJ). (2) DF, CRD to CofOrd, 24 Jul 57, sub: Type Clas of XM-386 Lchr for HJ. Both cited in OTCM 36609, 12 Sep 57. RSIC.

improved launcher be immediately type classified and released for industrial procurement in order to support the U. S. Army troop program and to meet the Army's commitment to the North Atlantic Treaty Organization (NATO). The Army was then committed to begin delivery of Honest John launchers to NATO nations in the second quarter of FY 1959 at a rate of no less than one battalion per month.

U (~~C~~) In September 1957, the M386 (XM-386) launcher was officially classified as standard and released for immediate procurement of 38 units under the FY-1958 program. The estimated quantity required for future procurement was 53 in FY 1959, 12 in FY 1960, and 12 in FY 1961. The modifications required to correct minor deficiencies were to be completed and a fully corrected production-type launcher made available to the Army Artillery Board for confirmatory evaluation by 1 October 1957. The standard M386 launcher, mounted on a 5-ton, M139-type truck, was about 10,000 pounds lighter than the M289, the latter weighing 43,750 pounds. In addition, it was considerably more compact, more adaptable for air transport, and cheaper to produce. The production cost of the M386 in quantity procurement (with chassis, less spare parts) was $93,600, in contrast to $109,000 for the M289.[25]

(U) The XM-78 heating and tiedown kit, mounted on the M55 truck bed, had been approved as a standard item, in July 1957, and redesignated as the M78. However, improvements were being applied to a lighter model designated as the XM-78E1. The M78 unit could transport two crated or uncrated rockets and tow the M329 trailer or the M405 handling unit, with a load of one rocket. The heavier M78 unit served the M289 launcher well, but only a lighter unit, such as the XM-78E1, was acceptable with the improved M286 and XM-33 launchers.[26]

(U) In May 1958, the Ordnance Technical Committee declared the M78

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[25] OTCM 36609, 12 Sep 57. RSIC.

[26] (1) OTCM 36578, 11 Jul 57. RSIC. (2) See also Johnson and Weston, op. cit., II, 193.

heating and tiedown unit as obsolete and standardized the lighter M78A1 (XM-78E1) model. At the same time, the M17 (XM-17E2) multimeter was type classified as standard, replacing the XM-17 circuit tester which became obsolete. The M17 multimeter was basically an ohmmeter used for electrical checkout of the rocket and associated fire control equipment, exclusive of warhead checkout.[27] The basic design of the XM-405 handling unit was still being reworked up to and beyond its standardization in May 1958. Even during its production phase, modification and redesign continued as conditions of its acceptability to the user.[28]

(U) The M2 (XM-2E2) electric blanket and the M35 firing control panel box were both standardized in July 1958. The blanket was a thermostatically controlled heating cover tailored to fit the external surface of the rocket and maintain the desired temperature of the preconditioned rocket motor.* At the end of FY 1957, 240 XM-2 blankets were already in the field with the M31 rocket and M289 launcher. In FY 1958, 124 more were issued to the troops, and 3 additional units were ordered for them. All of these XM-2 blankets were later exchanged for the M2 blanket on a one-for-one basis. The M35 firing control panel was a simple, portable, rugged, expensive unit which could be used interchangeably with both the Honest John and Littlejohn rockets. Also standardized with these items was the M56 protective cover which fitted over the M139 truck body. This tent-like cover was made of nylon weatherproof fabric over an aluminum frame. It not only protected the launcher from damaging weather conditions, but also provided camouflage, giving the launcher the undistinguished silhouette of an ordinary cargo truck.[29]

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*For a background history of the administrative and technical problems encountered in development of the electric blanket, see Mary T. Cagle, History of the Basic (M31) Honest John Rocket System, 1950 - 1964 (MICOM, 7 April 1964), pp. 114, 117, 119, 167-68, 180-93.

[27]OTCM 36798, 23 May 58. RSIC.

[28](1) OTCM 36797, 23 May 58. RSIC. (2) See Chapter VIII.

[29]OTCM 36831, 10 Jul 58. RSIC.

11-070-2115-218 | **ROCK ISLAND ARSENAL ORDNANCE CORPS** | February 17, 1960

PROTECTIVE COVER FOR LAUNCHER, 762MM ROCKET, TRUCK MOUNTED M386
LEFT SIDE, FRONT, COVER IN POSITION.

PROJECT NR. TW-200 **PHOTOGRAPHER: E.A. METZGER**

(C) Industrial Engineering (U)

(U) Product engineering on the XM-386 launcher and ancillary equipment actually began on a partial basis in April 1956 before completion of the developmental phase. This overlap was necessary because of the short time available between the R&D design of the system and the expected onset of user tests in mid-1957. Because of a delay in receipt of industrial engineering funds, this activity was carried out through August 1956 as part of a project funded for increasing the producibility of Ordnance materiel to reduce cost. In August, the Rock Island Arsenal received $200,000 for a separate industrial engineering project for improved Honest John ground equipment. The Arsenal's Engineering Division undertook product-engineering work on the XM-386 launcher, electric blanket, XM-4 handling beam, and XM-78 heating and tiedown kit. The XM-405 handling unit was designed and developed at Rock Island, but the OCO assigned the product engineering and procurement of this item to the OTAC.[30]

(U) Pre-Production Launcher Models

(U) In October 1956, the OCO sent the Ordnance Weapons Command (OWC) a program execution directive (PED) in the amount of $1,200,000 for procurement of three complete XM-386 launchers. The production order issued to the Rock Island Arsenal in mid-November 1956 called for the manufacture of three pre-production launchers and associated equipment for use in combined engineering-user tests. Two of the launcher sets were scheduled for completion in July 1957 and the third by January 1958.[31] (They were later identified as serial numbers 3, 4, and 5,

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[30] Johnson and Weston, Development and Production of Rocket Launchers at Rock Island Arsenal, 1945 - 1959, II, 209.

[31] (1) Ibid., II, 209, 210. (2) PED No. 70304011 15 40025 000254, OCO to CG, OWC, 22 Oct 56. ORDTU File, Sep - Dec 56, FRC.

numbers 1 and 2 being the R&D models.)

(U) Because of the short leadtime allowed for production, a large portion of the drawings used were the original R&D versions which had not been subjected to production-engineering study or revision. About one-third of the documentation released to the Rock Island Operations Division, in January 1957, consisted of production-engineered drawings; the remaining two-thirds were R&D drawings to which industrial numbers had been added. Product-engineering work on the latter was completed in June 1957; however, additional engineering studies were necessary because of the design changes and modifications needed to correct deficiencies noted in qualification tests of the R&D models.[32] Engineering change orders covering nearly 20 modifications had to be processed and mandatory changes applied to the pre-production models, making it impossible to complete the first two sets by the July 1957 target date.[33]

(U) The Watertown Arsenal fabricated the beams for the first two pre-production launchers (serial numbers 3 and 4); the third beam was made by the Rock Island Arsenal to incorporate a number of late drawing changes. The OWC headquarters procured three sets of XM-2E2 blankets from the Security Parachute Company. Other ancillary equipment procured for the three launchers included M405 handling units and XM-78E1 heating and tiedown kits. The Rock Island Operations Division manufactured three XM-78E1 heating and tiedown kits and one of the handling units. The Detroit Arsenal produced the other two M405 units.[34]

(U) The Rock Island Arsenal completed assembly of the first two pre-production launchers (#3 and 4) in October and November 1957, some 4 months behind schedule. The third model was not assembled until the early spring of 1958. After undergoing local engineering tests,

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[32] <u>See</u> above, pp. 174-78.

[33] Johnson and Weston, <u>op</u>. <u>cit</u>., II, 210, 266.

[34] <u>Ibid</u>., II, 266-67.

launchers 3 and 4 were shipped to the WSPG for use in a 24-round engineering-user test program which began in December 1957 and continued through mid-February 1958. Launcher 5 was held at Rock Island until September 1958, when it was released for Arctic tests in Alaska.[35]

(U) Concurrent with receipt of the first quantity production order for the M386 launcher, in December 1957,[36] the Engineering Division was assigned responsibility for providing production-engineering support and for following through with studies to improve the producibility, accessibility for maintenance, and functioning of the launcher system's components. The Arsenal had received $25,000 for initial engineering support in November 1957. This activity was still under way at the end of 1959, with a funding level of $174,800.[37]

(U) Two of the most persistent technical problems afflicting the M386 launcher were the occurrence of an annoying "chatter" in the elevating mechanism and a suspected launcher bias which was thought to be the cause of system inaccuracy. These problems continued to occupy the attention of engineering personnel from late 1956 on through the early 1960's, overlapping by several years the initial production deliveries in 1959. There were other problems, of course, but these two presented the greatest difficulty and deserve special treatment.

(U) <u>The "Chatter" Problem</u>

(U) Excessive chatter in the elevating mechanism had first gained notice in late 1956, during local testing of the initial R&D prototype at Rock Island. The source of the noise was an undesirable reversing of the double-elevating screw with single equilibrator in the top carriage of the launcher. The Arsenal reversed the advantage, using a

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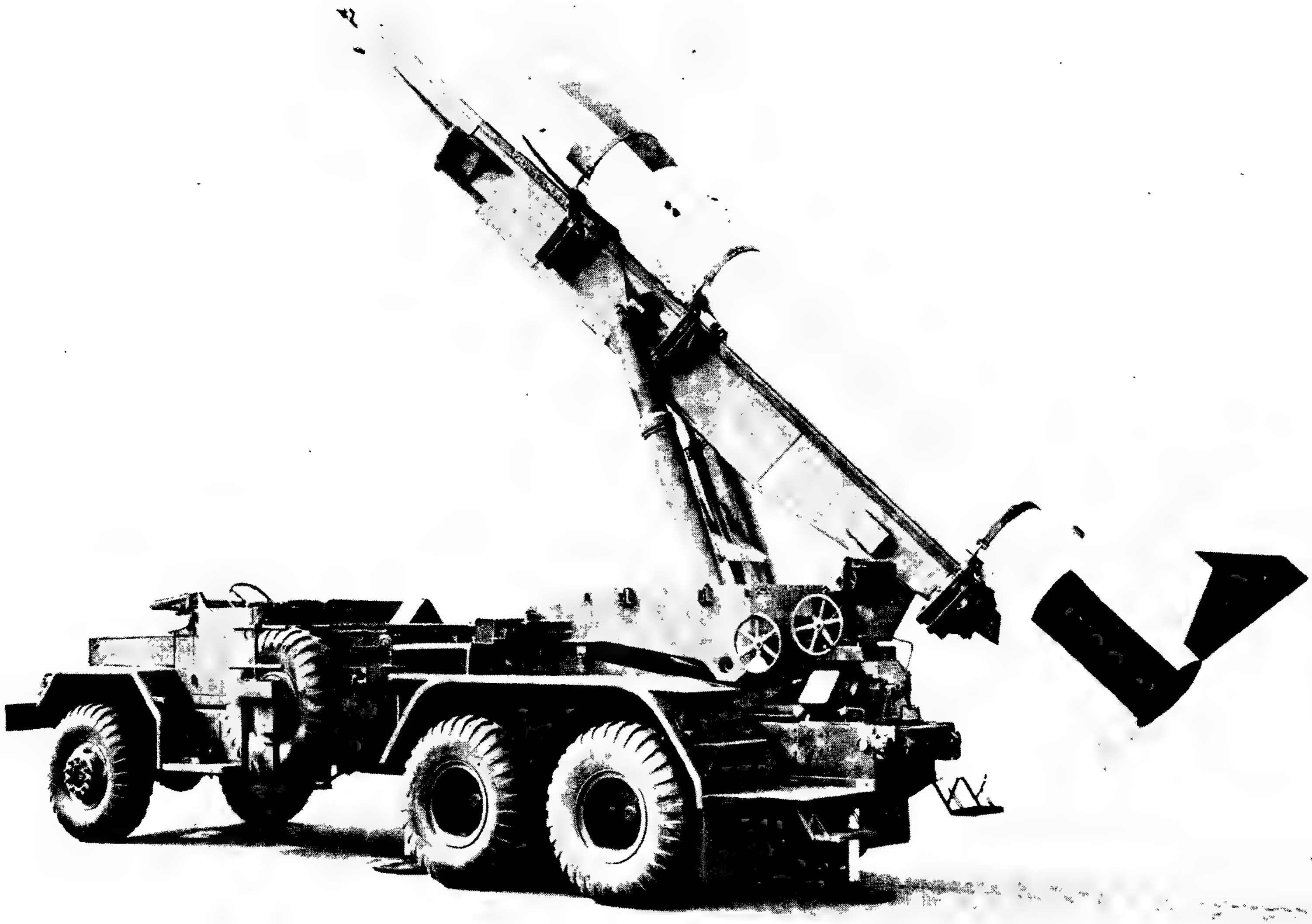
[35] _Ibid._, II, 211, 266.

[36] The Industrial Program is treated below, pp.

[37] Johnson and Weston, _op. cit._, II, 212.



2115-56594 | ROCK ISLAND ARSENAL ORDNANCE CORPS | October 8, 1957

Launcher, Rocket, 762-MM., Truck Mounted, XM386, Serial Nr. 3.
45^{o} Elevation, 0^{o} Travers.

single screw and two equilibrators. This eliminated the noise except during elevation of the launcher without the rocket in the range of 0^{o} to 38^{o}.[38]

(U) Later instrument firings from launcher #1 at the WSPG again brought complaints of chatter. The noise was temporarily stopped by threading the head of the elevating screw in place and keying it to prevent reverse rotation. Lead-plating and molybdenum-coating of the elevating screw on launcher #2 seemed to minimize the chatter, and a 6^{o} thread, instead of the 29^{o} thread used on launcher #1, further reduced it. The M386 launcher was standardized in September 1957, with its fast operating elevating mechanism: two equilibrators with a lead-plated, moly-coated screw with a 6^{o} thread.[39]

(U) Complaints of noise when elevating the rocket continued on report throughout 1958 and part of 1959. During a conference at Fort Sill, in June 1959, school personnel cited this noise as one of the several problems they were having with the improved Honest John rocket system. The ARGMA, the OWC, and the Rock Island Arsenal agreed to provide the school with the final results of M386 chatter tests, along with the plan and timeframe for making the necessary modifications and recommendations for interim use of the elevating assembly.[40]

(U) Both R&D and production-engineering talent proposed design changes to eliminate the reverse rotation of the elevating screw, one of the most popular being the use of an inertial brake or flywheel to produce drag. This innovation was tested, but it failed to correct the problem.[41] Late in 1959, the Rock Island Arsenal procured and tested a ball-screw assembly with a "no-bak" device to prevent reverse

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[38]WSPG HJ Actv Rept, Nov 56, n.p. ORDTU File, Sep - Dec 56, FRC.

[39]OTCM 36609, 12 Sep 57. RSIC.

[40]Min of HJ Conf at Fort Sill, Okla, 23 - 25 Jun 59. HJ R&D Case Files, Box 13-562, RHA AMSC.

[41]HJ Prog Rept, Oct 59, p. 10.

rotation of the elevating screw. This assembly eliminated the chatter with 90 percent efficiency, in contrast to 20 percent for the standard elevating screw, and it could be easily retrofitted to launchers already in the field. The device was later adopted as a part of the standard M386 launcher.[42]

(U) The Problem of Launcher Bias (U)

(U) A suspicion that launcher bias existed and was possibly affecting system accuracy took shape during qualification tests of the first R&D launcher in late 1956. Test firings of the M31 rocket, in November, had revealed some interference between the rocket and the last 5 feet of the launching rail. Blast deflectors failed to correct the situation; and it then appeared that rail rebound caused the interference rather than the blast itself. The extended rear shoes eliminated the rebound for the M31 rocket.[43] However, this change later proved unacceptable for positioning the improved XM-50 rocket.

(U) Tests of the first pre-production launcher, in October 1957, revealed that movement of the M31 rocket from the rear to the tip of the guidance rail caused a 1-inch deflection in the beam, with a resultant average change in the rocket's attitude of about 8 mils. At that time, the design engineers at Rock Island initiated studies on the launcher beam to determine whether dampness could cause the deflection. They concluded, in early 1958, that the effects of dampness were not significant enough to be included in the acceptance specification. The results of lateral deflection tests, conducted at Rock Island in the spring of 1958, were forwarded for analysis by the University of Illinois which was making a launcher dynamics study under contract with the Arsenal.

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[42](1) Johnson and Weston, op. cit., II, 196. (2) Ltr, Chf, HJ Sec, Proj Br, OML, to Col Harald S. Sundt, USMAAG, Copenhagen, Denmark, 14 Apr 60. HJ R&D Case Files, Box 13-562, RHA AMSC.

[43]See above, p. 176.

The university concluded that the amount of translation derived was not sufficient to harm the weapon's accuracy and that the angular change of the beam was more important as a factor affecting accuracy.[44]

(U) Initial XM-50 test firings from the modified M386 launcher (#1), in mid-1958, indicated excellent compatibility; however, range bias was still evident. Since continued tests indicated that the launcher might be the cause of this bias, it was again returned to Rock Island on 3 December for further study and modification. One of the design changes involved the lowering of the rear launching shoes which had been raised during qualification tests with the M31 rocket. The results of flight tests had shown that the XM-50 rocket did not require the higher rear shoes because of its higher thrust. After further launcher dynamic studies, Rock Island engineers concluded that the range bias was not caused by the M386 launcher but was the fault of the rocket itself.[45] This conclusion was the subject of much debate through the next several years.

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(~~S~~) During a meeting held at the WSMR in June 1959, representatives of rocket development agencies agreed that launcher bias did exist. Since the glide phase of the rocket had been corrected and the burnout angle was within specified limits, launcher bias, by elimination, seemed to be a logical subject in a study of system inaccuracy.[46]

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(~~C~~) In a preliminary response, the head of the Ballistic Research Laboratories (BRL) wrote the OCO, in August 1959, questioning whether the range bias differences cited were between the two launchers tested or among other factors. He pointed out that too many variables had entered into the testing. Launchers 3 and 4, the first two industrial prototypes, had been tested, one emplaced on concrete and the other on

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[44] Johnson and Weston, op. cit., II, 193-94.

[45] Ibid., II, 196.

[46] Min of XM-50 Rkt Dev Mtg at WSMR, 11-12 Jun 59. HJ R&D Case Files, Box 14-143, RHA AMSC.

soil; the tests had been made 6 months apart; the R&D firings had, at all elevations, a shorter range than the engineer-user firings. The BRL report noted that the apparent variation among launchers for range dispersion was about the same magnitude as that of rocket-to-rocket dispersion for firings from a single launcher, and was smaller than the standard deviation of impact range dispersion based on probable errors (PE's) in tests of the M386 launcher the preceding April.

(U) In connection with a previous CONARC proposal for specific calibration firings to correct for launcher bias, the BRL commented that essentially the same tests as those proposed had already been performed twice with negative results. If range and/or deflection bias should be established and if calibration firings should be adopted as a corrective measure, the laboratory warned that a number of complications could be expected. Calibration would be necessary at more than one elevation; a fairly large number of rockets would be required to furnish an accurate bias estimate at any one elevation; and, even if the cause of the bias should be isolated and corrected, there was still no assurance that this cause would remain a constant factor throughout the life of the launcher.[47]

(U) Concurrently, the Brown Engineering Company was working on a launcher dynamics study, using the same firing tables. The study report, submitted in August 1959, indicated that available test data was too incomplete to permit a thorough analysis of either the launcher or the rocket, or of their interaction. Limited analysis, however, left some question as to the effect of the launcher on impact deflection error.[48]

(U) In October 1959, the CONARC reiterated the need for establishing a positive course of action to determine the effect of the M386

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[47]Ltr, BRL, APG, to CofOrd, 27 Aug 59, sub: Reported Lchr Bias for the M386 HJ Lchr. HJ R&D Case Files, Box 13-562, RHA AMSC.

[48]Ltr, Brown Engineering Co. to OML, ARGMA, 10 Aug 59, sub: Study of HJ XM-50 Lchr Dynamics, Contr No. DA-01-021-506-ORD-611. HJ R&D Case Files, Box 14-125, RHA AMSC.

launcher on range bias. During a discussion of the problem in the OCO, a representative of the Army Artillery Board requested a study of the firing characteristics of prototype launchers 3 and 4 on the basis of engineer-user tests, as well as launcher beam straightness. The Chief of Ordnance agreed on the calibration firing program to obtain launcher dynamics data, using the two launchers assigned to the Artillery Board. The BRL was asked to analyze the data produced and to submit a report of findings by 1 October 1960.[49]

(U) Still not convinced that range bias was altogether the fault of the launcher, the BRL, in early 1960, made a detailed review of the Douglas Aircraft Company's November 1959 analysis of XM-50 R&D firings from the M386 launcher. This analysis also reflected some doubt that launcher-to-launcher variation affected system accuracy. The Company's engineers concluded that there was a straight-line relationship between launcher beam curvature and range-miss distance. Beam curvature correction, they said, would greatly improve launcher-rocket accuracy and would make straightening of the launcher rail unnecessary. A means of field measurement and correction of beam curvature was all that was lacking. A reasonable improved system objective, they concluded, would be a method of laying and setting the launcher to a 1-mil PE accuracy, in addition to correcting the curvature.[50]

(U) The Ordnance Weapons Command then initiated a study of three methods for measuring and correcting the beam curvature in the field: the wire method, the simplest but the least accurate; the autocollimator method, the most accurate but the most difficult to use and the most complex; and the simpler collimator method. The latter was

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[49] Ltr, USAARTYBD, Ft Bliss, Tex, to Pres, USAARTYBD, Ft Sill, Okla, 19 Oct 59, sub: Trip Rept of Lt Col Kajencki to Washington, D. C. HJ R&D Case Files, Box 13-562, RHA AMSC.

[50] (1) Ltr, BRL, APG, to CofOrd, 8 Feb 60, sub: Review of Results of R&D Tests of Rkt, 762mm, XM-50, Fired from M386 Lchr. (2) Ltr, BRL, APG, to CG, AOMC, 22 Apr 60, sub: same. File same.

[redacted]

adopted as the best all-around method during a conference held at Fort Bliss in late April 1960.[51]

U (~~C~~) Thirteen months later, the Improved Honest John System was in the field and apparently effective. However, the possibility of launcher bias continued to nag the project engineers whose goal for the system was perfection. Studies of launcher dynamics continued but with low priority.[52]

(U) R&D Cost of Honest John Ground Equipment

(U) During the 10-year period FY 1952-61, the Rock Island Arsenal received and spent a total of $2,780,169 for research, development, and product engineering on three launchers and ancillary equipment for the Basic and Improved Honest John Weapon Systems. In contrast, the cost of developing similar launcher systems for the Littlejohn rocket amounted to $8,095,900 over a period of 8 years (FY 1955-62).

(U) Although the improved M386 launcher system was basically a modification of the M289, its R&D-engineering cost actually exceeded that of the M289 by $63,169. Specifically, the cost of the M386 was $1,168,669 over a 6-year period (FY 1956-61), compared to $1,105,500 for the M289 over a like period (FY 1952-56, 1958). R&D funds allocated to the M33 launcher project at Rock Island amounted to $506,000.[53] The annual funding programs for the respective launcher projects are tabulated in Table 6.

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[51] Min of XM-50 Rkt Non-Firing Studies Mtg, Ft Bliss, Tex, 27-28 Apr 60. File same.

[52] Intvw, Elva W. McLin with Herman L. Martin, HJ Cmdty Ofc, MICOM, 15 Nov 64.

[53] (1) Johnson and Weston, Development and Production of Rocket Launchers at Rock Island Arsenal, 1945 - 1959, I, 18f. (2) Suppl Cost Data, FY 1959-61, RIA, 11 May 65.

[redacted]

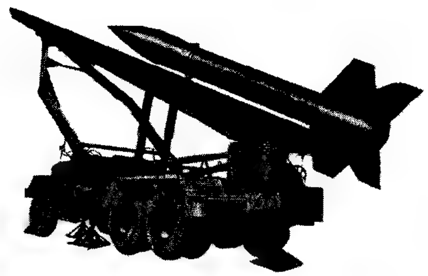
Table 6—(U) R&D Cost of Honest John Ground Equipment
Ordnance Project TU2-3008 - Rock Island Arsenal

Fiscal Year	M289	M386	M33	Total FY Expenditure
1952	$ 160,000			$ 160,000
1953	149,100			149,100
1954	428,400			428,400
1955	108,000			108,000
1956	200,000*	$ 446,000		646,000*
1957		300,000	$382,000	682,000
1958	60,000	177,000	15,000	252,000
1959		130,616	109,000	239,616
1960		50,000		50,000
1961		65,053		65,053
TOTAL:	$1,105,500	$1,168,669	$506,000**	$2,780,169*

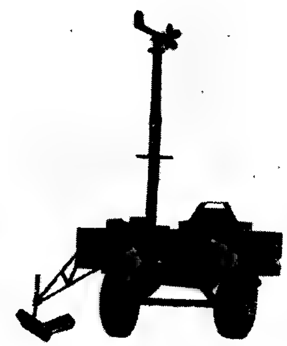
*Excludes $8,800 for Arctic Test with M31 Rocket funded under Ordnance Project TU2-1029.

**Represents only those funds allocated to, and spent by, the Rock Island Arsenal. Development costs incurred by the Watertown Arsenal are not available.

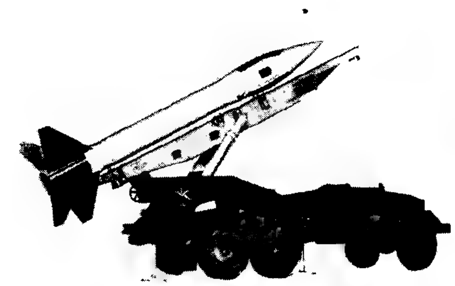
SOURCE: Johnson and Weston, op. cit., I, 18f; and Supplemental Cost Data, FY 1959-61, RIA, 11 May 65.



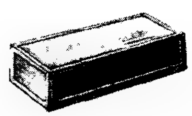
M-289 LAUNCHER MOUNTED ON
5 TON 6X6 TRUCK



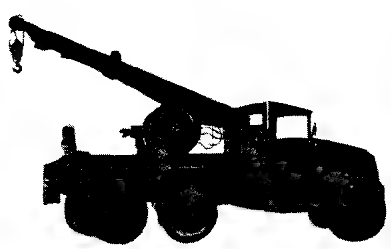
WIND MEASURING SET, AN/MMQ-1B



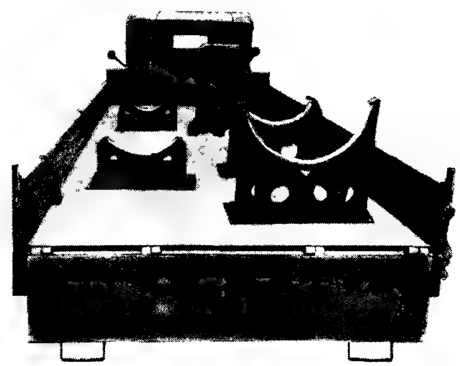
M-386 LAUNCHER MOUNTED ON
5 TON 6X6 TRUCK



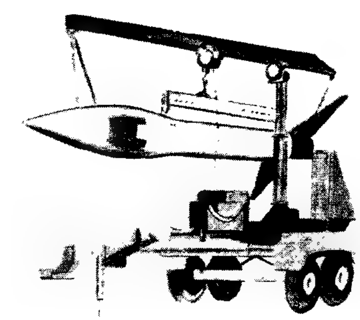
ELECTRIC BLANKET, M2E2



WRECKER, 5 TON, M-62



HEATING & TIE DOWN UNIT
TRUCK MOUNTED M78-E1



HANDLING UNIT, TRAILER M-405

ABMA
NO HJ-112 REV 8
DATE 20 OCT 61

HONEST JOHN LAUNCHER SYSTEM M386, M289, WITH ASSOCIATED EQUIPMENT

U (~~C~~) Procurement and Production (U)

U (~~C~~) The Rock Island Arsenal received the initial order for quantity production of the M386 launcher in early December 1957, less than a month after the second pre-production prototype left the assembly line.[54] The original order called for the manufacture of 38 launchers; but an amendment issued in May 1958 added 64 units to the order, increasing FY-1958 procurement to a total of 102. The Industrial Division of the OWC obtained trucks for the launchers and the M405 handling units from the OTAC, and also handled procurement of the M2 blanket, generators, and heating and tiedown kits.

U (~~C~~) In addition to manufacturing most of the launcher components and assembling the complete launcher, the Rock Island Arsenal installed the heating and tiedown kits on the M55 truck beds; manufactured the rocket handling beams and slings, protective covers, and a variety of maintenance equipment and spare parts; and procured circuit testers and other accessories such as tool sets. It also prepared and packaged for shipment spare parts and equipment for the launcher, rocket, heating and tiedown kit, and handling unit.[55] The Arsenal completed assembly of the first production launcher on 10 February 1959. Delivery of the 102 sets procured under the FY-1958 program was completed in February 1960.[56] The total cost of these M386 launchers with ancillary equipment and concurrent spare parts amounted to $8,657,462.[57]

U (~~C~~) Meanwhile, the Ordnance Weapons Command, in December 1959, received a second production order for 10 M386 launchers and 79 M78A1 heating and tiedown kits. The Rock Island Arsenal began production of

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[54] See above, pp. 178-79, 183-84.

[55] Johnson and Weston, op. cit., II, 267-68.

[56] Ibid., II, 268.

[57] Ibid., I, 26f.

these additional units in February 1960. The 10 M386 launchers (including equipment and spare parts) were produced at a cost of $941,209, making a total of $9,598,671 for the 112 units. This amount, together with a cost of $1,173,411 for the 79 M78A1 kits, brought the total value of industrial procurement to $11,342,082 through FY 1960.[58] Between FY's 1960 and 1965, the Arsenal built and delivered 123 additional M386 launcher sets, making a grand total of 235.[59]

(U) Signal Corps Development of Meteorological Equipment (U)

(U) Of all the problems carried over from the Basic to the Improved Honest John Program, the one concerned with development of wind measuring equipment presented the greatest challenge. This equipment was vitally important to both Honest John systems, for the achievement of desired accuracy was largely dependent upon precise measurement of wind speed and direction to correct rocket aim in the final seconds before launch.

(U) The Signal Corps designed, developed, and produced the wind measuring sets by special arrangement with the Ordnance Corps. Under this arrangement, the weapon system manager at the Redstone Arsenal level had no technical or supervisory control over the program and was therefore powerless to influence the direction or speed of development. The Signal Corps, moreover, seemed disinclined to accept direction even from the Chief of Ordnance. Despite repeated efforts to expedite the program, the Ordnance Corps still had not received a fully acceptable wind measuring set as late as 1960. In June of that year, the ARGMA complained that the Signal Corps' "limited development in this area . . . has in no manner been commensurate" with weapon system needs. "The equipment and techniques," it warned, "are totally inadequate and

[58] Ibid., I, 26f; II, 272.

[59] AMP FY 1963-70, May 65 (draft), pp. 253-54. HJ/LJ Cmdty Ofc File.

impose a most significant compromise to overall system accuracy and effectiveness."[60] To place this unfortunate situation in proper perspective, it is necessary to review the program from its inception nearly a decade earlier.

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(~~C~~) Wind Equipment for the Basic System (U)

(U) The first wind measuring set, designated as the AN/MMQ-1, was designed and developed by Signal Corps agencies, using an interim statement of military characteristics furnished by the Ordnance Corps in December 1951. Following field tests of an experimental model, the Signal Corps Engineering Laboratories (SCEL) assembled six tactical prototypes which were subjected to joint engineering tests in 1952-53. These tests revealed a number of serious deficiencies, such as structural failures and unreliable wind data readings. The design changes then made in the equipment eliminated major structural deficiencies; however, the problem of obtaining reliable wind data at the desired level was far from solved.

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(~~C~~) The results of Honest John weapon system tests, conducted in the spring of 1954, indicated that the large dispersion errors stemmed directly from the lack of reliable wind information. An analysis of the test data revealed that the AN/MMQ-1 wind equipment could not give reliable surface wind information in the region up to burnout (about 3,000 feet). Consequently, wind corrections fed to the launcher were frequently in error and wide dispersion was inevitable. The Chief of Ordnance then learned, in April 1964, that Signal Corps meteorologists knew very little about wind action in the region from about 200 to 3,000 feet—this representing the approximate region from launch to burnout where the free rocket is the most susceptible to wind and other factors affecting dispersion. Signal Corps agencies were then conducting

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60 HJ Msl Sys Plan, ARGMA MSP-11, 1 Jun 60, p. 31D.

research to gain more knowledge in this area; but it would take several years to accumulate data to fully solve the problem.

(U) Pending a final solution to the problem, the Army Field Forces[*] requested that the AN/MMQ-1 wind measuring set, as modified to include an improved averager, be classified as substitute standard, and that a limited number be procured to meet immediate requirements of Honest John units already deployed. The Army General Staff, in October 1954, approved the equipment for interim tactical use and directed the Chief Signal Officer to procure sufficient quantities to meet user requirements.

(U) Subsequent field and laboratory tests of the modified unit, later in 1954, disclosed a number of new deficiencies which rendered the equipment unfit for field use. In addition to nine general deficiencies noted in tests at Fort Sill, the CONARC reported that the averaging-type instrument panel was unsatisfactory in several important respects. The main complaint concerned the time required to attain a full-scale reading. For example, in the case of a 1-mile-per-hour wind, it took 3.6 minutes for the averager to attain 63 percent of full-scale reading, and about 10 minutes to attain a full reading. The time required to attain the partial reading naturally varied according to wind velocity, but the time to attain a full reading remained substantially constant at 10 minutes. In practice, this meant that correction factors fed to the launcher would be based on the average value of winds which passed 10 minutes before launch time. The CONARC also found that the averager was difficult to zero and would drift as much as 20 mils in 1 hour.[61]

(U) Some of the reported deficiencies were ultimately eliminated

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*Later redesignated and hereinafter referred to as the Continental Army Command (CONARC).

[61] See Mary T. Cagle, History of the Basic (M31) Honest John Rocket System, 1950 - 1964, pp. 193-99.

through modification of interim tactical equipment; others posed complex problems which were not completely solved until the early 1960's. It is these problems and their solutions to which this summary now turns.

(U) Improved Wind Measuring Equipment (U)

(U) Continued testing convinced the Ordnance Corps that the lack of reliable wind information was the greatest enemy of system accuracy. But the Signal Corps argued that more accurate wind equipment would be incompatible with mobility requirements of the system, since an accurate wind set must be solidly and permanently emplaced.[62]

(U) During the Honest John Steering Committee meeting on 14 January 1955, a CONARC representative presented a paper outlining the results of recent investigations made in the use of pilot balloons to determine surface wind corrections. He noted that the results of 36 practice firings at Fort Sill and Fort Bragg, using both tactical wind equipment and pilot balloons, had confirmed suspicions that the tactical equipment was giving unsatisfactory results under field conditions, balloon measurements in these tests being consistently more accurate. In this view, he recommended that the pilot-balloon technique be further investigated by using it in conjunction with tactical equipment in all future firings of the Honest John rocket. Accordingly, the committee members requested that the Wind Studies Subcommittee conduct a thorough feasibility study of the balloon technique. They also agreed that balloons would be used with tactical wind equipment in as many firings as possible to accumulate additional data for statistical evaluation.[63]

(U) The Chief of Ordnance concurred in the plan for checking out

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[62] RSA Semiannual Hist Sum, 1 Jan - 30 Jun 55 (2 vols), II, 128.

[63] (1) Ltr, 00/5C-2207, CofOrd to Chf, Met Br, ESCL, Belmar, N. J., 31 Jan 55, sub: Sur Wind Detm by Bln for HJ. (2) CONARC Paper, "Use of Pilot Balloon to Determine Surface Wind Corrections for Honest John." Both in ORDTU File, Jan - Apr 55, FRC.

the balloon technique, but warned that it might never prove tactically suitable. The fixed gear essential to adequate balloon readings, he said, would defeat efforts to achieve complete mobility in the improved Honest John system.[64]

(U) One of the first actions taken by the Wind Studies Subcommittee, in March 1955, was the preparation of a set of proposed MC's to provide guidance for development of improved equipment. The Signal Corps, it will be recalled, had developed the initial wind set along guidelines set out in the interim MC's issued in December 1951. To achieve the desired accuracy for the improved Honest John, it was now imperative that a definite set of MC's be established for the development of adequate wind measuring equipment. The Chief of Ordnance, in late April 1955, forwarded the suggested MC's to the Chief Signal Officer with a request that he submit his comments and recommendations at the earliest convenient date.[65]

(U) The earliest convenient date for the Signal Corps came 9 months later. The Chief Signal Officer replied, on 24 January 1956, that it was yet too early to establish formal MC's for wind measuring equipment. Pending the completion of research then under way, he recommended that no formal MC's be adopted. "When sufficient basic knowledge has been obtained, Military Characteristics for wind measurment (sic) for Honest John will be recommended."[66] The only course of action open to the Chief of Ordnance was to concur in this position and hope for an early technological breakthrough. He wrote the Redstone Arsenal, in early

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[64] Ltr, CofOrd to CG, RSA, 8 Apr 55, sub: HJ Imprv Prog - RSA Rept 3M51P dated 11 Mar 55. File same.

[65] (1) Min, Wind Studies Subcom Mtg at RIA, 15 Mar 55, incl to Ltr, Chf, Met Br, ESCL, to CofOrd, May 55, sub: Transmittal of Min of Mtg (15 Mar 55) of Subcom on Wind Studies. ORDTU File, May - Aug 55, FRC. (2) DF, 00/5C-9584, CofOrd to CSigO, 28 Apr 55, sub: Ord Proj TU2-1029, Char for Sur Wind Meas Equip. ORDTU File, Jan - Apr 56, FRC.

[66] DF Cmt 2, CSigO to CofOrd, 24 Jan 56, sub: same. File same.

February 1956: "When sufficient basic knowledge has been obtained on which a set of reasonable MC's can be based, it is the intention of this office to recommend that such MC's be drafted and adopted without delay."[67]

(U) Meanwhile, members of the Wind Studies Subcommittee met at the Aberdeen Proving Ground, in May 1955, to consider ways of improving the interim AN/MMQ-1 set. They abandoned experiments of the portable, mechanical mast, begun earlier in the year, after hearing reports that it was not as reliable as the standard mast. Instead, they proposed further development of the SCEL's research mast which was mounted on a 2 1/2-ton, 6x6 truck and was capable of extension to 165 feet. Representatives of the SCEL reported successful tests on the AN/MMQ-1 with a laboratory model averager.[68]

(U) The subcommittee, later in 1955, recommended procurement of the improved AN/MMQ-XE3 (averager) wind set to accompany the XM-289E1 launchers. Although the CONARC still had not released the item, it was the general consensus of the committee members that the XE3 was at least equal to, if not better than, the interim set, and that only XE3 sets should be procured. In passing this information on to the Chief of Ordnance, the Commanding General of Redstone Arsenal noted that only three XE3 wind sets were on order, as opposed to a considerably larger quantity of launchers, adding that the production leadtime for wind sets was 1 year. He also urged that the Signal Corps be given immediate authority to proceed with fabrication of the wind set using the improved 165-foot mast, so that the equipment would be available for initial flight tests of the improved system in the fall of 1956.[69]

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[67] Ltr, OO/6C-2426, CofOrd to CG, RSA, 1 Feb 56, sub: MC's for Sur Wind Meas Equip - Proj TU2-1029. File same.

[68] Min, Wind Studies Subcom Mtg, APG, 11 May 55. ORDTU File, May - Aug 55, FRC.

[69] Ltr, CG, RSA, to CofOrd, 12 Dec 55, sub: Ord Proj TU2-1029, Proj Status. ORDTU File, Sep - Dec 55, FRC.

(U) The Chief of Ordnance agreed to ask the Signal Corps to procure additional XE3 wind sets, since this appeared to be the CONARC choice. With regard to the 165-foot mast, he said CONARC considered this an R&D problem but would interpose no objections if responsible agencies felt that one should be built and tested. In the latter connection, he advised that CONARC's views were apparently at variance with those of the Signal Corps, and that an attempt would be made to resolve the differences at an early date.[70]

(U) By late March 1956, it had become evident that developmental tests scheduled to begin in October would have to be conducted with the interim wind set. A few weeks earlier, the Redstone Arsenal had urged the Chief of Ordnance to obtain approval of the MC's for development of improved equipment to include an accurate wind intelligence system. However, the Chief Signal Officer adamantly insisted that sufficient information still was not available to establish MC's or to permit initiation of such development. Even if adequate knowledge were immediately available, he reported, an improved wind set could not be delivered in time for the scheduled October tests because funds were not available for new development. The lack of funds for this purpose had been brought to the attention of the CRD by both the Chief Signal Officer and the Chief of Ordnance; however, there was no assurance that the necessary funds would be forthcoming.[71]

(U) In view of these and other untoward developments, representatives of the CRD and the Chief of Ordnance met at the CONARC headquarters in the late spring of 1956 to discuss the status of wind equipment for both the Honest John and the Littlejohn helicopter-transportable system. With the Signal Corps' long-range research project still months

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[70] Ltr, 00/5C-27840, CofOrd to CG, RSA, 22 Dec 55, sub: Proj TU2-1029. File same.

[71] 2d Ind, CofOrd to CG, RSA, 26 Mar 56, on Ltr, 00/6C-2426, same to same, sub: MC's for Sur Wind Meas Equip - Proj TU2-1029. ORDTU File, Jan - Apr 56, FRC.

away from completion, sufficient basic knowledge of surface wind conditions was not yet available to determine if new measuring equipment should be developed. However, if the CONARC so desired, the existing AN/MMQ-1 set could be made more sensitive and more portable by breaking it down into man-transportable packages. Also, arrangements could be made, if desired, for the Signal Corps to develop a new lightweight mast so that the set would be more compatible with the Honest John and Littlejohn helicopter-transportable systems. In the absence of sufficient knowledge to prove or disprove the adequacy of existing equipment, the Commanding General of CONARC advised against major redesign of the equipment at that time. He went on to say, however, that serious consideration should be given to redesign and repackaging if the research studies would not produce improved wind measuring equipment before completion of the optimum Littlejohn helicopter-transportable system. As an interim measure, he recommended that the AN/MMQ-1 be accepted for both weapon systems; that an additional helicopter be procured for transportation; and that consideration be given to a "quick fix" to reduce the overall weight of the equipment without major redesign.[72]

(U) During the Heavy Rocket Steering Committee Meeting on 12-13 June 1956, representatives of the SCEL presented a proposal for repackaging the AN/MMQ-1 to make it man- and helicopter-transportable. The configuration did not include any radical redesign features for greater wind sensitivity, since the crash nature of the program did not permit such effort. The SCEL representatives assured the committee that redesign to achieve more suitable wind equipment was proceeding as rapidly as time and funds would permit. They requested that two 2 1/2-ton trucks be furnished for mounting the experimental 150-foot anemometer masts, which had been contracted for by the SCEL. The committee asked that the wind measuring equipment be delivered complete with balloons

[72] Ltr, ATDEV-1 400, CG, CONARC, to OCRD, DA, 29 May 56, sub: Wind Meas Equip for HJ & LJ HTS. ORDTU File, May - Aug 56, FRC.

and theodolites for more dependable wind intelligence.[73]

U (~~C~~) In mid-July 1956, the Redstone Arsenal requested that the Chief of Ordnance place a requirement with the Chief Signal Officer to furnish the necessary wind measuring equipment to complete the R&D phase of the Honest John program. The delivery schedule for testing at the WSPG called for two lightweight sets by mid-October 1956 to be used with the lightweight (XM-289E1) launcher; and two standard AN/MMQ-E1 sets and one double theodolite balloon, in early March 1957, for use in engineer-user tests of the XM-386 launcher. One modified AN/MMQ-E1 set would be required in July 1957 and two more in December 1957 for engineer-user tests of the improved Honest John rocket.[74]

U (~~C~~) The CRD, in September 1956, concurred in an Ordnance Corps procurement request for 35 wind sets, in addition to those under procurement for use with the standard M289 launcher. Of these, 20 were earmarked for Class IV stock; 4 for the 101st Airborne Division; 2 for the Artillery and Guided Missile School; 5 for Ordnance support; and 4 for R&D and engineer-user test. The CRD requested that the DCSLOG confirm these requirements with the Chief Signal Officer so that they could be included in his program without delay.[75] Several months earlier, the Chief of Ordnance had alerted the Signal Corps to prepare for delivery of eight sets as quickly as they could be fabricated, followed by eight additional sets for issue to troops in August and November 1957, respectively, and the balance as soon thereafter as possible.[76]

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[73] DF, CofOrd to Met Sec, OCSigO, 21 Jun 56, sub: Met Equip for HJ & LJ. File same.

[74] Ltr, CG, RSA, to CofOrd, 16 Jul 56, sub: Additional AN/MMQ-E1 & Ltwt Wind Meas Sets for HJ & LJ Rkt Sys. File same.

[75] (1) DF Cmt 3, CRD/C-9488, to DCSLOG, 1 Sep 56, sub: Met Equip for HJ & LJ. (2) DF, CRD/C-13114, to same, 26 Sep 56, sub: same. Both in ORDTU File, Sep - Dec 56, FRC.

[76] DF, CofOrd to Met Sec, OCSigO, 21 Jun 56, sub: Met Equip for HJ & LJ. ORDTU File, May - Aug 56, FRC.

(U) In the meantime, the Signal Corps submitted a status report, in early July 1956, on its wind measurement research studies. While a complete solution to the problem of wind measurement for tactical rockets was not yet available, the research studies had yielded some basic information toward such a solution. For example, the Corps' R&D Division had designed and was in the process of fabricating an improved low-level wind measurement set (later designated as the AN/PMQ-6) which featured a hand-operated, lightweight, 50-foot mast. An experimental model would be delivered to the WSPG, in August 1956, for test with the XM-33 helicopter-transportable launcher.

(U) The Signal Corps laboratories were also in the process of evaluating the final report of low-level wind studies by the North American Instrument Corporation; but it was yet too early to tell when the results of the studies could be applied to development of improved or final equipment. At the same time, they were in constant communication with the University of Michigan researchers who were working under contract on specific wind measurement requirements, and with the Redstone Arsenal which was also conducting wind measurement research.[77]

(U) The first prototype model of the lightweight AN/MMQ-E1 wind set arrived at the WSPG in October 1956 for testing with the Honest John/Littlejohn helicopter-transportable systems. A series of R&D operational tests, conducted in conjunction with members of the Army Artillery Board, revealed numerous minor deficiencies, as well as a lack of field reliability, which were reported to the Signal Corps for corrective action.[78] (The AN/MMQ-E1 was later standardized as the AN/MMQ-1A.)

(U) Two AN/PMQ-6 wind measuring sets were released for test in

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[77] DF Cmt 2, CRD, OCSigO, to CRD, DA, 3 Jul 56, sub: Wind Meas Equip for HJ & LJ HTS. File same.

[78] (1) Ltr, Hq, Bd Nr 1, Ft Sill, Okla, to CG, CONARC, 27 Dec 56, sub: Eval of Ltwt Hel Transbl Wind Meas Set for LJ Sys. (2) Ltr, CG, CONARC, to CRD, DA, 22 Jan 57, sub: same. Both in ORDTU File, TU2-1029 Wind Equipment, Jan - Aug 57, FRC.

April and July 1957, respectively, to determine whether or not the equipment would qualify as a replacement for the AN/MMQ-1 series. Constructed mostly of aluminum and weighing a light 485 pounds, this lightweight surface wind measuring set could be broken down into five packages and transported by six men for distances up to 100 yards. It was equipped with a 50-foot pneumatically operated telescoping mast which used bottled, compressed air. The aerovane anemometer, mounted on the mast and oriented in the direction of fire, transmitted electrical impulses to an averager which converted them to range and cross-wind velocity readings in miles per hour (mph). The anemometer and averager were the same as those used with the standard AN/MMQ-1A wind set.

(U) The Artillery Board found the new AN/PMQ-6 set just as capable as the standard set, in addition to being much lighter, simpler to operate, easier to support, and faster to emplace and displace. The aluminum set, however, was not rugged enough to withstand sustained field operations and therefore did not qualify to replace the AN/MMQ-1 series for use in the self-propelled Honest John system. Another major fault stemmed from the use of high-pressure, bottled air which presented safety and handling problems requiring special precautionary measures. The Board concluded that the AN/PMQ-6 wind set, when modified to correct deficiencies, would be suitable for use with the interim Littlejohn and the lightweight Honest John (XM-33) systems. It recommended that the equipment, when modified, be classified as standard type, and further that the research and development be continued to provide a man-transportable wind set of improved durability for use with the lightweight and self-propelled Honest John/Littlejohn systems.[79]

(U) Despite the availability of the improved wind sets mentioned above, at least one major problem was yet unsolved as late as 1960. The results of engineering tests of the improved XM-50 rocket in the

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[79] Rept of USAARTYBD, Proj Nr FA 2157, "Service Test of Wind Measuring Set, AN/PMQ-6," 23 Aug 57. File same.

spring of that year revealed a serious accuracy problem that could only be solved by a reliable method of correcting the launcher for wind movement in the final seconds before firing. This problem was finally resolved by a remote lay device which provided a positive means for reducing the time lag in wind-reading to fire and a simple remote control of launcher elevation and azimuth.

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(~~C~~) With the remote lay device, wind correction could be effected in the crucial 2 to 4 minutes before firing. These final minutes were particularly critical for the Honest John free-flight rocket, since a change in wind velocity of only 3 miles per hour could result in an error of as much as 9 mils. The remote lay device provided continuous wind corrections, both before and between firings, using a series of electric motors controlled either manually or electronically from a console in the firing pit. It promised an 18 percent improvement in system accuracy and afforded an easy retrofit.[80] A modified wind set was successfully tested with the M386 launcher in 1961. Thereafter, all three of the Honest John launcher systems were modified to incorporate the remote lay principle.[81]

(U) The AN/PMQ-6 wind measuring set, adopted for use with the lightweight M33 launcher, was type classified as Standard A on 28 September 1959. The AN/MMQ-1 and 1A wind sets, used with the self-propelled M289 and M386 launchers, remained in service as Standard A until June 1964, when they were reclassified as Standard C. At the same time, the final AN/MMQ-1B wind measuring set was type classified as Standard A.

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[80] (1) Ltr, John A. Robins, HJ Proj Engr, to Col Harald S. Sundt, USMAAG, Copenhagen, Denmark, 14 Apr 60. (2) Min, XM-50 Rkt Non-Firing Studies Mtg at Ft Bliss, Tex, 27-28 Apr 60. Both in HJ R&D Case Files, Box 13-562, RHA AMSC.

[81] (1) DF, ABMA Control Ofc to ABMA Comdr, et al., 2 Mar 61, sub: Weekly Sum of HJ, LJ, & Msl A Firings (22-28 Feb 61). (2) DF, same to same, 15 Jun 61, sub: Weekly Sum of HJ, LJ, & Msl A Firings (1-13 Jun 61).

M31 Rocket/M386 Launcher System on Site in Hawaii, 8 August 1961.

All of these sets were capable of providing crosswind and rangewind readings from 0 to 50 miles per hour. They consisted essentially of an anemometer on a portable, trailer-mounted mast having an extended length of 50 feet, 1 inch, and a retracted length of 9 feet. In a tactical operation, the wind set is generally placed about 5 yards forward and 25 yards to the left or right of the launcher.[82] (Note position of the wind set in the accompanying photograph.)

[82] AMCTCM 2320, 2 Jun 64. RSIC.

CHAPTER VII

[redacted] THE M33 HELICOPTER-TRANSPORTABLE LAUNCHER (U)

(U) The M33 Helicopter-Transportable Launcher (HTL), commonly known as the Chopper John, is the product of a highly accelerated development effort initiated in February 1956. Originally, the tactical capability offered by the Chopper John was to have been provided by the Littlejohn weapon system, the development of which had begun in February 1955, with a target date of 1 August 1957 for initial troop delivery. When the Littlejohn program fell behind schedule, the Army General Staff directed the Ordnance Corps to expedite development of a lightweight launcher for the Honest John rocket to provide an interim system for the newly reactivated 101st Airborne Division.[1]

[redacted] <u>Preliminary Studies</u> (U)

(U) Concurrent with development of the standard M289 launcher during the 1952-54 period, several contract studies had been made of design possibilities for lighter weight, more mobile launchers.[2] The ACF-Brill Motors Company design, reported in August 1953, became the object of intensive scrutiny of engineers at both the Redstone Arsenal and the Rock Island Arsenal, since it offered promise of air-transportability. This design of an expendable, lightweight, portable, 1-shot launcher unquestionably provided military engineers and mathematicians with a point of departure for the eventual development of the M33 helicopter-transportable launcher.[3]

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[1] <u>See</u> above, pp. 47-48.

[2] <u>See</u> Cagle, <u>History of the Basic (M31) Honest John Rocket System, 1950 - 1964</u> (MICOM, 7 April 1964), pp. 201-214.

[3] RSA Rept 3J16P, 29 Mar 56, sub: Project Plan, Development of Helicopter-Transportable System for Rocket, 762mm, 31A1, HJ, p. 2. RSIC.

(U) The proposed ACF-Brill launcher seemed impractical, but some of its individual features showed promise. It had a 25-foot guidance, shorter by 5 feet than that of the M289 launcher; a weight of 4,000 pounds, in contrast to almost 42,000 pounds for the M289; and a tripod formed by the launching rail itself and two adjustable supporting legs. Varying the length of the bipod legs would permit fine azimuth and elevation adjustments up to 3°. The launcher was to be delivered to the site in a knocked-down condition, and would then be erected by a 3-ton wrecker or similar vehicle to an elevation between 15° and 50°. Particularly valuable was the portability concept.[4]

(U) During the next several years, the Redstone Arsenal, the Rock Island Arsenal, and the Douglas Aircraft Company all prepared preliminary studies of lightweight, towed, rail-type launchers to accompany the improved Honest John system. In general, the improved system, in its helicopter-transportable phase, benefitted from all the knowledge gained in the continuing Littlejohn and improved Honest John development. Douglas Aircraft had completed the design for the Littlejohn, originally dubbed the Honest John, Jr., in September 1953, as a smaller caliber companion system to the Honest John rocket system.

(U) The final Douglas report of the essential components of an improved Honest John rocket, in November 1954, prompted a Department of the Army requirement for the rocket itself, a rocket which was to be capable of launch from both a self-propelled launcher and a lightweight launcher. The proposed lightweight launcher, as recommended by Douglas, would have a 15-foot guidance rail, half as short as the rail on previous launchers. It would be air-transportable, including airdrop, for Phase I operations (airborne operations), and for Phase II operations (including cargo helicopter of the H-24, H-21 class). Efforts to develop a self-propelled launcher for the Littlejohn system were later terminated,

[4] _Ibid._, pp. 2-3.

but both launcher types became an integral part of the improved Honest John concept.[5]

(U) The Redstone and the Rock Island Arsenals assayed the knowledge available and collaborated on a report issued by the Redstone Arsenal in early August 1955. The study concluded that a helicopter-transportable Honest John system was feasible and that the Douglas Aircraft Company design, with certain Rock Island Arsenal modifications, was compatible with available helicopters in load and space requirements. The launcher was to weigh about 2,000 pounds, have the shortened 15-foot guidance rail which the Douglas report had recommended, and be at least as accurate as the heavier M289 launcher, which had a guidance rail twice that length.[6]

(U) Informal conferences with the prospective field artillery users at Fort Sill brought in further suggestions for improvement, with the result that several concepts evolved for an Honest John helicopter-transportable system. A conference at Fort Sill with representatives of the Redstone Arsenal, in May 1955, had narrowed the field of study to a single "best concept," and, with some modification, this is the concept later designated the XM-33 helicopter-transportable launcher.

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(~~S~~) The White Sands Proving Ground completed tests on 4 November 1955 to determine the feasibility of the 15-foot guidance. These tests seemed to substantiate the Douglas Aircraft Company's claims for its efficiency.[7]

U
(~~S~~) The Department of the Army established a requirement, in September 1955, for the complete Littlejohn rocket system, including

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[5] <u>See</u> above, pp. 47-49, 61-63.

[6] RSA Rept 3M71P, 1 Aug 55, sub: HJ Sys Adaptable for Trans by HR2S Hel. RSIC.

[7] (1) TT, WSPG to OCO, 8 Nov 55. (2) Ltr, CG, RSA, to CofOrd, 12 Dec 55, sub: Ord Proj TU2-1029, Proj Status. ORDTU File, Sep - Dec 55, FRC.

the lightweight helicopter-transportable launcher as an essential of both Phase I and Phase II operations. The Littlejohn would serve as a companion system to the basic Honest John system as well as an interim system, a forerunner of the more mobile improved Honest John system.

(U) In Phase I operations, the lightweight helicopter-transportable rocket system would provide lightweight nuclear warhead delivery capability for the 101st and other airborne divisions. In Phase II operations, the simple, rugged, highly mobile rocket system would include a self-propelled launcher for Army divisions, as well as a helicopter-transportable system for airborne units. The newly reactivated 101st Airborne Division was to receive Phase I operations equipment, including the helicopter-transportable launcher, which was still in the planning stage, at the earliest practicable date—tentatively by 16 July 1957.[8]

(U) In response to the Army requirement, the OCO then directed the Redstone Arsenal to propose a specific plan for design and development, under an accelerated program, for a helicopter-transportable improved Honest John rocket system. The direction included field delivery, to follow authorization for a crash program by only 12 months. The Redstone Arsenal submitted a plan, in October 1955, proposing a helicopter-transportable launcher as essential to the improved Honest John system during Phase I and Phase II operations, just as it was with the interim Littlejohn system.[9]

(U) At the request of the Chief of Ordnance, the CONARC, in December 1955, submitted a statement of military characteristics for the proposed helicopter-transportable launcher. The weight was to be not more than 3,700 pounds, since the launcher was to be towed for short distances by an H-21 or an H-34 helicopter. The launcher was to be transportable

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[8] ABMA Semiannual Hist Rept, 1 Jul - 31 Dec 60, pp. 158-160.

[9] RSA Rept (unnumbered), 4 Oct 55, sub: Proposed Hel-Transbl HJ Wpn Sys. ORDTU File, Sep - Dec 55, FRC.

inside and outside of the H-37 helicopter. Standard light vehicles were to be able to tow it on the ground. In addition to these advantages over the existing launcher, it was to be at least as accurate in launching the Honest John rocket.[10]

U
(~~C~~) Launcher Design, Development, and Test (U)

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(~~C~~) By early 1956, the preliminary studies and discussions had shown such promise that the CRD endorsed the helicopter-transportable launcher program and set it in motion. He directed the Chief of Ordnance, in February 1956, to initiate development of a helicopter-transportable launcher for the improved Honest John system and to deliver this as interim equipment by July 1957 to meet the immediate needs of the 101st Airborne Division. The Chief of Ordnance, after studying the development plans, asked for a time extension of from 1 to 3 months, but the CRD insisted that the July delivery date was essential to plans for the 101st.[11]

(U) Meanwhile, recognizing the urgency of the requirement, the OCO had already directed the Redstone Arsenal to begin this development, under 1-A priority, using funds available to the Honest John Improvement Project, TU2-1029.[12] The Redstone Arsenal, with its work under way already on the design study, delegated to the Rock Island Arsenal the fabrication of two platform-type R&D launchers, for preliminary testing of the concept. The Watertown Arsenal took over this task, however,

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[10] Ltr, ATDEV-1 471.94, CG, CONARC, to CofOrd, 7 Dec 55, sub: Proposed MC's for HTL for 762mm Rkt HJ and Assoc GHE. ORDTU File, Sep - Dec 55, FRC.

[11] (1) DF, CRD, DA, to CofOrd, 15 Feb 56, sub: Initiation of HJ HTL Prog. (2) TT, CofOrd to CG, RSA, 28 Feb 56. (3) Ltr, CRD, DA, to CG, CONARC, 30 Mar 56, sub: HTL for HJ. All in ORDTU File, Jan - Apr 56, FRC.

[12] TT, CofOrd to CG, RSA, 28 Feb 56, ORDTU File, Jan - Apr 56, FRC.

before the Rock Island shops had passed the preparation stage. Time was short, and the Rock Island shops had a heavy workload with the previously assigned XM-386 launcher development.[13]

(U) The platform models had much of the general configuration of the proposed lightweight launcher. The launchers were stabilized by being bolted to concrete or by being placed on terrain. A crane elevated and lowered the beam when necessary. The overall weight was just a little more than that planned for the lightweight launcher—about 2,500 pounds, as opposed to 2,000 or 2,200 pounds. The Redstone Arsenal planned the development and fabrication of three tactical launchers, following tests of the two R&D launcher platforms.

(U) The basic plan for the improved Honest John rocket system, including the lightweight launcher, took final form at the 14 March 1956 meeting of representatives of the Ordnance Weapons Command, the Rock Island Arsenal, the Douglas Aircraft Company, the Redstone Arsenal, and the host, the WSPG. The meeting's overall objective was planning a system capable of rapid deployment of Honest John firepower in areas not readily accessible to the self-propelled system, and arranging to complete such a system in as short a time as possible.

(U) The Redstone Arsenal had carried the major pre-development responsibility in this program for the past several months and had already drawn up its plan. Its report, published later that month, detailed a proposed calendar in the development program: an immediate concept study during March and April 1956; design and fabrication for the 12-month period from April 1956 through March 1957; and within this period, feasibility tests in August 1956, to be followed by development tests from August 1956 through May 1957. Final development was scheduled for completion in October 1957, with the launcher to be ready for

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[13] Johnson and Weston, <u>Development and Production of Rocket Launchers at Rock Island Arsenal, 1945 - 1959</u> (2 vols, RIA, Aug 1962), II, 198.

user-testing on 1 November 1957. The 1 November date was 5 months later than the date which the Department of the Army had set up for the 101st Airborne Division to receive the helicopter-transportable launchers.[14]

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(~~C~~) The Watertown, Rock Island, and Redstone Arsenals all prepared concept studies and presented these at a Rock Island meeting during the week of 15 April 1956. The Ordnance Weapons Command, operating under unrelenting pressure, pointed out that, while all the proposals had merit, the Watertown study would be selected for development. Otherwise, the Watertown Arsenal would find itself in the untenable position of abandoning the shop work already begun, setting up for a start on a new concept, and so being unable to meet the required delivery dates for the two R&D launchers.[15] The Watertown Arsenal presented an Honest John helicopter-transportable launcher platform model at the June meeting of the Heavy Rocket Steering Committee. The OCO representative directed adoption of the Watertown concept, in view of the critical nature of the time schedule.[16] The proposed nomenclature assignment, the XM-33, became official in July 1956.[17]

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(~~C~~) In June 1956, the CRD noted apparently irreconcilable problems inherent in the XM-33's military characteristics. The MC's required that the launcher be both helicopter and aircraft transportable during Phase I operations. The helicopter transportability could be achieved only with minimum weight. The aircraft transportability, involving the rigors of airdrop, could be achieved only with maximum ruggedness, obtained usually with heavier weight. The designers, he noted, seemed

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[14] RSA Rept 3J16P, 29 Mar 56, sub: Proj Plan, Dev of HTS for Rkt, 762mm, M31A1, HJ, pp. 3-9, 18-27. RSIC.

[15] Monthly Prog Rept, HJ Proj TU2-1029 & TU2-3008, Apr 56. ORDTU Files, Jan - Apr 56, FRC.

[16] Ltr, CG, RSA, to CofOrd, 28 Jun 56, sub: Ord Proj TU2-3008, HJ HTS. ORDTU File, May - Aug 56, FRC.

[17] 1st Ind, 00/6C-14011, CofOrd to CG, RSA, 10 Jul 56, on Ltr, CG, RSA, to CofOrd, n.d., sub: Nomen Asg for HJ Lchr. File same.

to be aiming at the minimum weight for helicopter transportability, sacrificing the maximum ruggedness for air transportability. He offered, as a practical solution, concentration on the helicopter transportability and abandonment of the airdrop requirement, and suggested to the CONARC that the Chief of Ordnance be notified of this change of emphasis.[18]

(U) Launcher platform feasibility tests at the WSPG, in the summer and fall of 1956, exposed the problem of weight adjustment, but not to the extent that had been feared. The overall results indicated a satisfactory compromise. The Rock Island Arsenal's tests in June, as well as the White Sand's tests from the two R&D platforms between 24 July and 16 October, demonstrated that a 3,500-pound launcher could successfully launch a rocket weighing almost twice as much. Hopefully, an even lighter launcher could achieve equal accuracy. The WSPG had fired 20 rounds from the two R&D platform launchers at elevations ranging from 10° to 50° with generally successful results.[19]

(U) The CONARC continued its insistance on the MC's previously set up for the XM-33 helicopter-transportable launcher, including the airdrop capability, but now expressed serious doubts of the lightweight launcher's airdrop fitness. At this point the platform launcher had performed well in transportability and firing tests, but had not yet undergone airdrop testing. The experts scrutinized the MC's, re-examining the desired tactical advantages of the launcher. The OCO finally reaffirmed airdrop capability as essential to the helicopter-transportable launcher concept. Parachute delivery of the optimum Littlejohn system remained a requirement, which was to be met by all components of the system. Parachute delivery of an Honest John helicopter-transportable launcher was still

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[18] (1) Ltr, CRD, DA, to CofOrd, 10 May 56, sub: Air-Drop Capability, HJ & LJ Sys. (2) Ltr, same, to CG, CONARC, 2 Jun 56, sub: HTL's for HJ & LJ. File same.

[19] (1) HJ Actv Rept, WSPG, Sep 56, n.p. (2) TT, CG, RSA, to CofOrd, 23 Oct 56. Both in ORDTU File, Sep - Dec 56, FRC.

desired. Weight and other differences were to be reconciled, even at the cost of more time and money.[20]

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(~~C~~) The Redstone Arsenal immediately took measures to insure aerial delivery capability, estimating the total cost of the additional airdrop protection for the launchers at $250,000 during FY 1957 and 1958. No major modification was required for the extra protection, a fact which accounted for the low cost estimate. The CONARC would fabricate drop kits and conduct the necessary drop tests; the R&D agencies would instrument the equipment. Specific needs, such as landing sleds or protective crating to protect the launcher on impact, would emerge from these tests.[21]

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(~~C~~) An even lighter weight remained the object of some design study, but a heavier 4,000-pound weight gained temporary preference because of its promise of launcher durability. At the heavier weight, the launcher could withstand airdrop and still be capable of either external or internal transport by a single M-37A helicopter or by sling from an H-34 helicopter.

(U) In September 1956, representatives of the Ordnance Weapons Command, the Rock Island Arsenal, and the Redstone Arsenal met at the Watertown Arsenal to appraise the concepts of the prototype launcher and the progress being made on the development of ground-handling equipment. They reviewed the original program plan which set delivery of lightweight helicopter-transportable handling and loading equipment for October 1956. Manufacture of the one side-loader and the one end-loader, with their dollies and slings, had fallen behind schedule at the Watertown Arsenal, delaying equipment testing. The Watertown Arsenal blamed an ABMA-assigned extra priority workload for the schedule lag. The assembled

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[20] DF, 00/6C-16759, CofOrd to CRD, DA, 13 Aug 56, sub: Feas of Aerial Dlvry of HJ & LJ Sys. ORDTU File, May - Aug 56, FRC.

[21] Ltr, CG, RSA, to CofOrd, 19 Sep 56, sub: HTL's for HJ and LJ. ORDTU File, Sep - Dec 56, FRC.

representatives suspected also that the Watertown-designed equipment, adopted so arbitrarily that summer, would prove too bulky and awkward to handle, even if delivered on time.[22] The weight and bulk of the launcher were subsequently trimmed. Both loaders were shipped to Rock Island, in February 1957, for preliminary testing, and then to the WSPG for test with the platform launchers.[23]

(U) Pilot Model Production and Test

(U) The Ordnance Weapons Command told the Watertown Arsenal to go ahead with its building of three pilot model launchers, incorporating the improvements recommended after R&D testing of the launcher platforms. That Command was still dissatisfied with the launcher's ground-handling equipment and ordered the Rock Island Arsenal to produce an alternate design.

(U) The Rock Island Arsenal later contracted with the Mast Development Company of Davenport, Iowa, to develop a third design and, upon the completion of these two designs, sent them to White Sands for appraisal. The WSPG recommended that the Rock Island design, with certain minor modifications, be used with the pilot model launchers. The Rock Island Arsenal then built or contracted for three sets of ground-handling equipment. Each set included an insulating blanket, a thermometer case, a handling beam, a transport cart, a rocket motor sled, a warhead skid, a gantry and hoist, a rocket motor helicopter sling, and a warhead helicopter sling.

(U) Because of basic differences in size and weight characteristics, as compared with the other Honest John launchers, the designers of ground-handling equipment for the XM-33 launcher were not much concerned over

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[22] Johnson and Weston, op. cit., II, 198-99.

[23] RSA Sum, Jan 57, Test Plan for Evaluation of Handling and Loading Equipment for Honest John HTS. HJ R&D Case Files, Box 15-95, RHA AMSC.

interchangeability of parts with the bigger and heavier XM-386 and M289 ground-handling equipment.[24] The three launchers shared certain equipment necessary for protecting, loading, and firing the improved Honest John rocket, but the XM-33 launcher itself was basically new in design and had few characteristics in common with the M289 launcher which supported both the basic and improved systems, or with the XM-386 launcher, designed specifically for the improved system. The ground-handling equipment for the XM-33 system had to be compact and light. These characteristics were not important at all with the M289 ground-handling equipment and not essential with that of the XM-386. The equipment of these latter two remained interchangeable. For this reason, the XM-33 launcher had its own system, an integral part of the Chopper John.

(U) From the beginning, the program had proceeded under pressure. The revised schedule called for delivery of four XM-33 launchers with equipment to the 101st Airborne Division by November 1957, in addition to the prototype launchers, incorporating the improvements indicated in the prototype testing.[25] The first two prototypes arrived separately at the Rock Island Arsenal for preliminary testing in May and early June 1957. Tests with the ground-handling equipment assembled at Rock Island resulted in only minor redesign. These two prototypes, produced primarily for flight testing, were then shipped to the WSPG for air delivery and firing tests, scheduled for June. The third launcher model, planned for major modification based on results of the tests of the first two, and for operational testing, left Watertown for the WSPG in June, where it remained for engineer-user test.

(U) According to the project plan, the first two launchers should have been available for the preliminary testing on 1 March 1957, and the

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[24] Johnson and Weston, op. cit., II, 199.

[25] RSA Sum, Jan 57, Test Plan for Eval of Hdlg and Loading Equip for HJ HTS. HJ R&D Case Files, Box 15-95, RHA AMSC.

third should have been ready for major modification on 1 May, at the completion of the WSPG tests of the first two. With 2 months allowed for major modification and 3 for minor modification, the 1 November deadline for delivery had seemed reasonable to the planners. The late delivery of the first two prototypes threatened to snowball, forcing delays throughout the program.

(U) Covering the emergency, the Rock Island Arsenal advanced the establishment of major modification requirements to feed into launcher prototype 3, basing these modification requirements on deficiencies showing up during the Rock Island tests, rather than on those showing up later during the White Sands air delivery and firing tests. To further the determined speed-up effort, the Arsenal hand-carried these modification requirements to the Watertown Arsenal.[26] The Watertown Arsenal modified launcher prototype 3 accordingly. The time lag was almost made up, and, as already noted, all three prototypes arrived at the WSPG in June 1957.

(U) The WSPG had already informed the Redstone Arsenal that the abbreviated schedule did not permit thorough testing and, because of this, they could not formally release the four XM-33 launchers for user test by the deadline delivery date of 1 November 1957. In fact, they could not make such a complete release until April 1958. A "conditional" release could be made on 1 November for testing for safety, serviceability, accuracy, and for recommendations for delivery to the troops.[27]

(U) The Redstone Arsenal Commander had influenced the speed-up of lagging delivery dates and now turned his efforts to a speed-up of lagging test schedules. Only an early June testing would still allow the

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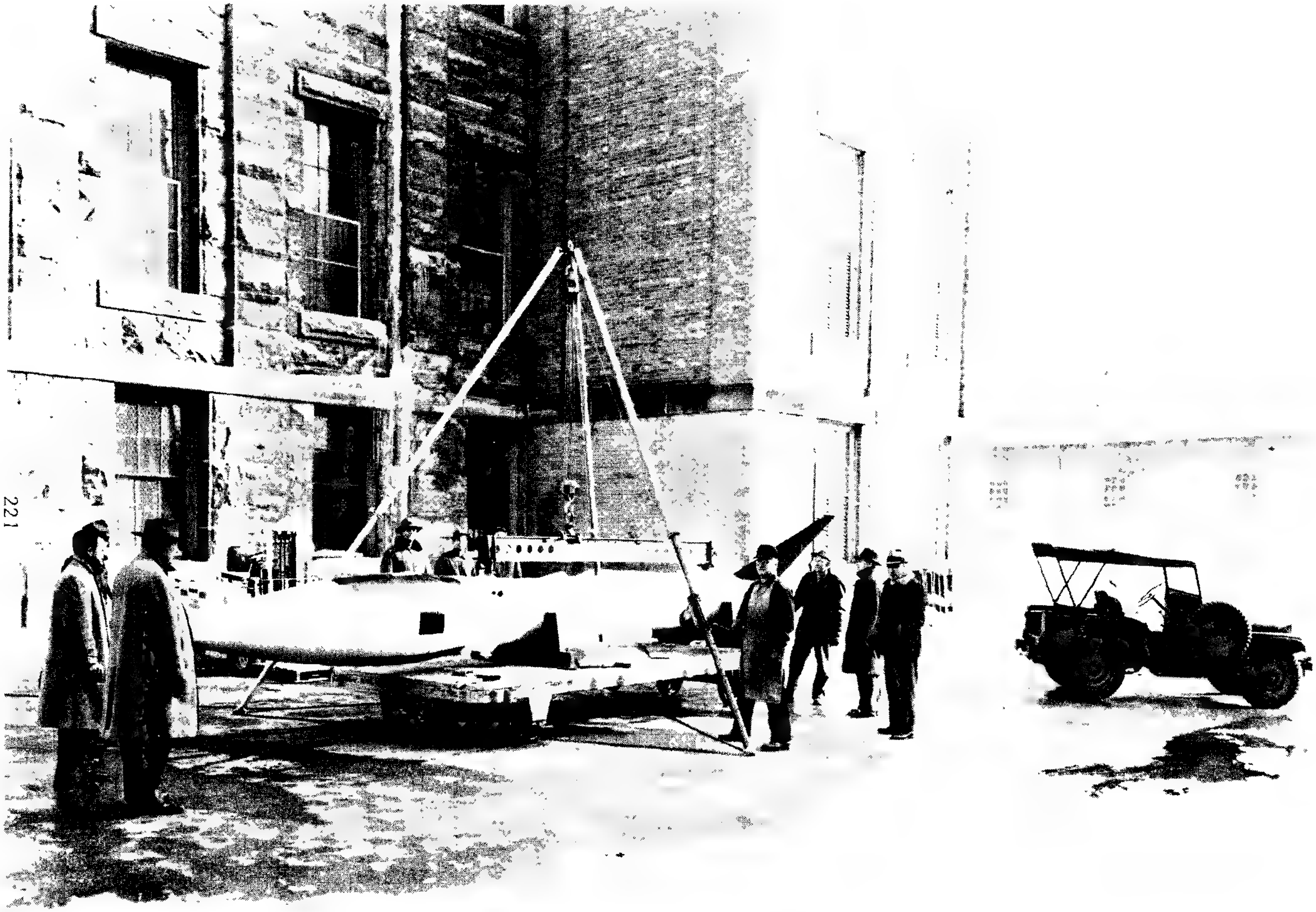
[26] TT, CG, RSA, to CG, OWC, 25 Apr 57. (2) Ltr, CG, OWC, to CO, WA, & CO, RIA, 17 May 57, sub: XM-33 HJ HTL. (3) Ltr, CG, OWC, to CO, WA, & CO, RIA, 23 May 57, sub same. All in HJ R&D Case Files, Box 15-95, RHA.

[27] TT ORDDW-MKP-4157, CG, RSA, to CofOrd, 29 May 57. HJ R&D Case Files, Box 15-95, RHA AMSC.



1100-57239 | ROCK ISLAND ARSENAL ORDNANCE CORPS | February 3, 1958

Tripod, XM33 Launcher Mock Up, 762-MM. Rocket, HJMTL Handling Equipment.

full time necessary for modifications, making possible the 1 November delivery date for user test. The WSPG proceeded methodically, however, checking out the prototype launchers after receipt and scheduling the first tests for 19 July. The first firing was delayed, set up on 25 July, and postponed again at X-75 seconds because of range power failure which allowed the rocket temperature to exceed the conditioned temperature of $0^{\circ}F$. The first two firings actually came off on 30 July 1957, 2 months later than the tight schedule had demanded.[28] The 23-round test program was successfully completed in late October 1957.[29]

(U) As a result of the tests, the pilot launchers and their handling equipment underwent some modification. The firing blast had broken a turnbuckle and anchor chain on launcher 1, and both were strengthened on later launchers. The Rock Island Arsenal modified the first two handling sets and redesigned the electric blanket to accommodate both the XM-50 and the M31 rockets. The design engineers also reinforced the gantry, but found it still not strong enough. They then devised a tripod of their own and later purchased another with a chain hoist from the W. E. Wallace Company. The Arsenal also made heavier slings, to minimize vibration on the rocket at certain helicopter speeds; redesigned the transport cart with a lower center of gravity; and made minor revisions to other components of the system.

(U) By early 1958, these modifications had been incorporated in all 4 launcher sets scheduled for delivery to the 101st Airborne Division. The WSPG had rejected the commercial tripod in favor of the Rock Island-designed tripod, which incorporated a 3-ton hoist. The Quartermaster Corps was supplying new and heavier slings.[30] The CONARC, in coordination with the Redstone Arsenal, began a re-evaluation of Honest John

[28] (1) TT, CG, RSA, to CG, OWC, 25 Apr 57. (2) TT ORDDW-MKP-4271, CG, RSA, to CofOrd, 12 Jul 57. (3) MFR, FONECON, WSPG to RSA, 25 Jul 57. (4) TT, CG, WSPG, to CofOrd, 30 Jul 57. File same.

[29] See Appendix A.

[30] Johnson and Weston, op. cit., II, 201.

lightweight equipment to determine its suitability for air transport in appropriate aircraft, for aerial delivery by parachute, and for transport by H-21, H-34, and H-37 helicopters.[31]

U (~~C~~) Engineer-User Test and Design Refinement (U)

(U) In February 1958, the four XM-33 launchers, complete with sight unit XM-43E1 and ground-handling equipment, were transferred to the CONARC for expedited engineer-user (E-U) testing. In March, April, and May, the Artillery Board and the Airborne and Electronics Board fired 22 rounds from the Chopper John system, and conducted operational tests of the XM-33 and the trailer for parachute delivery and for helicopter external transport. Operational tests indicated that the M31 rocket with the XM-33 launcher would survive airdrop, as well as both internal and external helicopter delivery; and there was no reason to doubt that the XM-50 rocket would also test successfully. In August, the Artillery Board evaluated the recent modifications made to the XM-33 launcher and set up an E-U check test. Two sets of handling equipment reached the 101st Airborne Division that summer and the other two sets arrived in December 1958. Subsequent user tests at Fort Bliss brought CONARC approval, with only minor defects to be corrected on the handling sets.[32]

U (~~C~~) The Airborne and Electronics Board determined, in November 1958, that the XM-50 rocket, with the XM-33 launcher system, was air transportable and, under favorable conditions, also helicopter transportable. The favorable conditions included specific ranges of altitude, humidity, temperature, and travel distances. These conditions were necessary because of the weight of the XM-50 rocket, rather than its other

[31]Ltr, CG, CONARC, to Pres, USAAEBD, Ft Bragg, N.C., 3 Sep 57, Sub: Reevaluation of HJ Ltwt Rkt Sys Equip for Aerial Dlvry & Air Trans. HJ R&D Case Files, Box 15-95, RHA AMSC.

[32]Johnson and Weston, <u>op</u>. <u>cit</u>., II, 202.

characteristics. The Board recommended that the rocket motor on its transport cart (XM-465) ride inside the C-119, the C-130A, the C-123, and the C-124 aircraft; inside the H-37 helicopter; and externally, by sling, from the H-37 helicopter. With the handling beam attached, the rocket on the cart could ride externally, for a limited distance under favorable conditions, from the H-21 and the H-34 helicopters. At the same time, the Board confirmed the prediction that the new rocket could be fired successfully from any of the three launchers of the improved Honest John system--the M289, the M386, or the XM-33. When mounted on a tactical crate skid and when weather conditions were favorable, it could also be airdropped.[33]

U ([redacted]) The first Arctic testing of the XM-33 launcher took place during the winter of 1958-59 and was carried further the following winter. During the first test, the 82d Airborne Division incorporated a limited H-21 helicopter lift in their brief exercise at Fort Richardson, Alaska. The ground-handling equipment passed its tests successfully the same winter at Fort Greely, Alaska. The Redstone Arsenal's Ordnance Missile Laboratories and the CONARC's Arctic, Airborne and Electronics, and Artillery Boards participated in the tests. A representative of the Laboratories reported that tracked and helicopter transportation of the improved Honest John system were best for Arctic use and insisted that the wheeled vehicle had no place in the Arctic. He recommended the use of the conditioner, or electric blanket, on the XM-50 rocket at all times. The new version of the conditioner cycled at 20° and because of this had proved more efficient in the Arctic than the first blanket version, which cycled at 70°, melted the snow, and caused ice to form. He also recommended that future Arctic tests be planned at the R&D stage

[33] CONARC Rept of Proj AB 3258, USAAEBD, 14 Nov 58, sub: Svc Test of Rkt, 762mm, XM-50; and CONARC Tentative Rept, same Board, 18 Feb 59, sub: same. HJ R&D Case Files, Box 13-562, RHA AMSC.

of the equipment, so that needed modifications could be made at a less costly level.[34]

(U) The CONARC testing during 1958 and 1959 was preliminary to the acceptance of the XM-50 rocket for field artillery use with the M289, M386, and XM-33 launchers. The Army General Staff would then be able to initiate procurement, before classification of the XM-50, and so permit the Ordnance R&D release of the XM-50 rocket on schedule, in October 1959.[35]

(U) The three CONARC Test Boards coordinated their service tests under 1A priority. Fort Bliss was the scene of Phase I air transportability tests for parachute delivery, assault landing, and helicopter transport. Phase II tests used developmental warhead rounds fired from the M386 launcher at all ranges and from the XM-33 launcher at long range.

(U) The official CONARC report of the Arctic tests contained several recommendations concerning the rocket, all of which were approved. In response to a recommendation that the XM-33 launcher for Arctic use be tracked rather than wheeled, the Army Chief of Research and Development replied:

> Your recommendation that investigation continue for an XM-33 launcher being mounted on a full tracked chassis to provide cross-country mobility for Arctic winter conditions is not favorably considered. It is believed that helicopter mobility available with the XM-33 launcher meets the requirement for specific operations - and funds are not available to provide tracked launchers.[36]

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[34] Trip Rept, 26 Mar 59, John A. Robins, OML Proj Engr, to Ft Richardson & Ft Greely, Alaska. HJ R&D Case Files, Box 13-562, RHA AMSC.

[35] Ltr, CG, CONARC, to CONARC Test Boards (USAATBD, USAAEBD, USAARTYBD) 6 Oct 58, sub: Svc Test of Rkt, 762mm, XM-50 (DA Proj 517-05-008; RDB Tech Obj LC-4). File same.

[36] 1st Ind, CRD, DA, to CG, CONARC, 28 Sep 59, on Ltr, CG, CONARC, to CRD, sub: Final Rept of Test of Proj Nr AKB 2259, Svc Test of Comps of Imprv HJ Rkt Sys. File same.

(U) The 1959-60 Arctic tests brought out seven deficiencies in the XM-33 launcher system, all of which proved minor and correctible by modification. The eighth deficiency, the inherent incapability of wheeled vehicles to move in deep snow, brought a renewed interest in providing the XM-33 launcher with tracks. The ABMA reported to the AOMC in August 1960:

> (U) Feasibility studies have been completed that will provide a track-mounted system utilizing the XM-33 series launchers. This launcher could be mounted on the basic T-113 chassis without degradation of performance of either piece of equipment. Further, this could be accomplished without any major modification to the launcher or to the tracked vehicle.[37]

The using agencies, however, seemed satisfied with helicopter delivery and emplacement of the XM-33 under Arctic conditions. Consequently, the suggestion that tracks be employed to provide mobility in snow was again shelved.

(U) Type Classification and Quantity Procurement (U)

(U) The Department of the Army approved the classification of the XM-33 launcher as limited production type in early April 1959. The launcher and major items of ground support equipment were officially designated as follows:

Launcher, Rocket, 762mm: XM-33
Trailer, Rocket, 4-wheel: XM-465
Hoisting Unit, Tripod: XM-29
Cradle, Rocket Warhead, Aerial Delivery: XM-4
Cradle, Rocket Motor, Aerial Delivery: XM-5
Basket, Delivery, Rocket Equipment: XM-1
Box, Shipping and Storage, Rocket Motor Fins: XM-34

The General Staff authorized immediate procurement of 27 launcher sets

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[37] 2d Ind, ABMA Comdr to CG, AOMC, 24 Aug 60, on Ltr, CofOrd to CG, AOMC, 17 Aug 60, sub: Rept of Proj Nr ATB 1-10, Svc Test of HJ Ltwt Rkt Sys, XM-33 series (DA Proj Nr 5-17-05-008, RDB Tech Obj LC-4). HJ R&D Case Files, Box 13-562, RHA AMSC.

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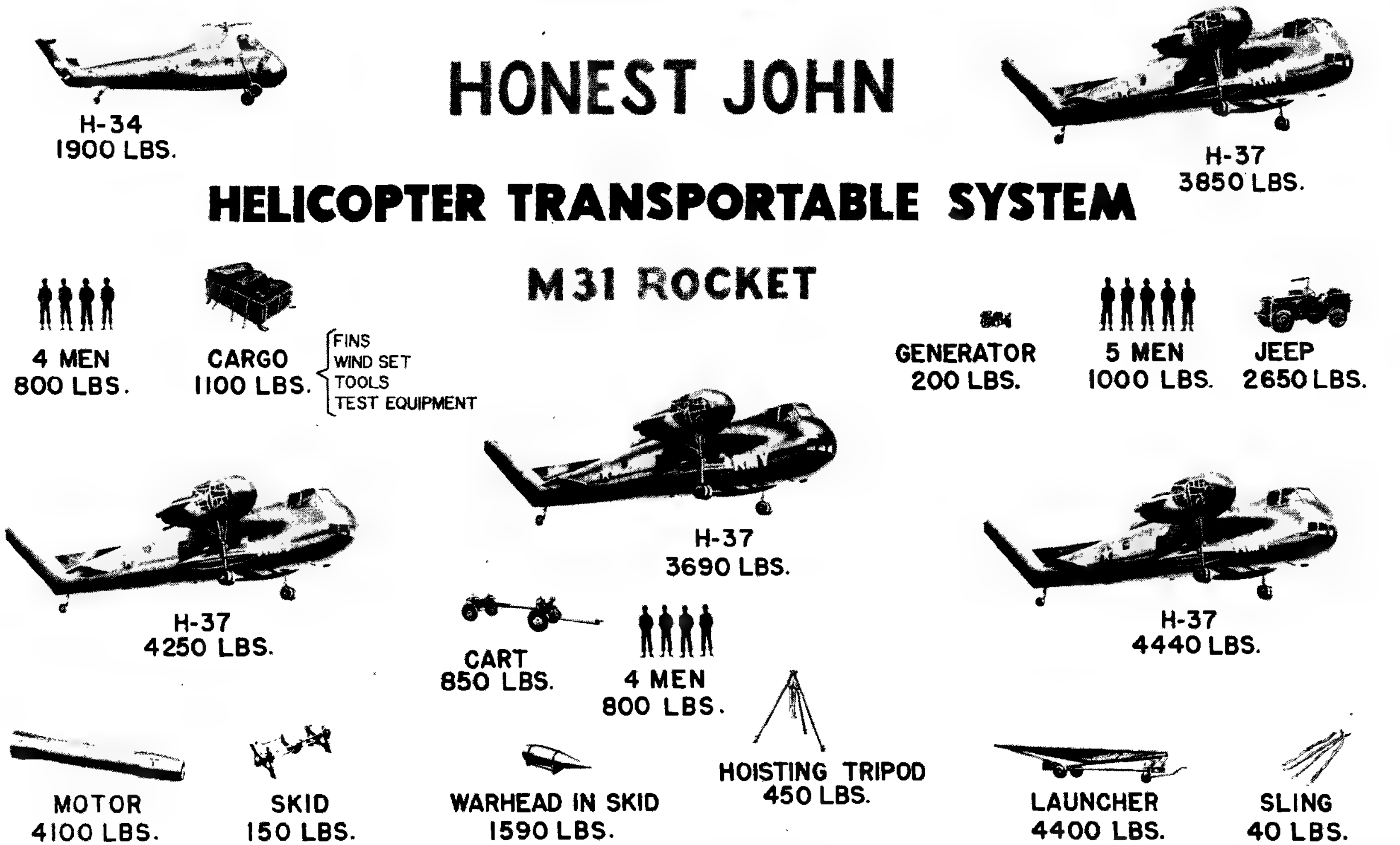

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with distribution as follows: 4 to the 101st Airborne Division; 4 to the 82d Airborne Division; 4 to the Army Artillery and Guided Missile School; 8 to the U. S. Army, Europe (USAREUR); 4 to the U. S. Army, Pacific (USARPAC); and 3 to the Ordnance Corps for non-tactical use as production models. Upon receipt of production equipment by the 101st Airborne Division, the four pre-production models issued in 1958 were to be returned for modification to correspond with production equipment. When modified, the equipment would be sent to the Artillery Board for confirmatory test. Meanwhile, research and development would be continued to improve the operational capability of the XM-33 system preparatory to type classification as a standard military item. Obligations under the XM-33 launcher program through FY 1959 amounted to $1,905,500, including $774,500 in R&D funds and $1,131,000 in PEMA funds.[38]

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(~~C~~) The Ordnance Technical Committee initiated action to classify the XM-33 launcher system as standard type in July 1960, but the action could not be implemented until final staff approval in April 1961. At the time of the July action, six improved items of ground-handling equipment had been developed for use with the standard M33 (XM-33) launcher:

Hoisting Unit, Tripod, Warhead Assembly: M32 (XM-32)
Cradle, Rocket Warhead, Aerial Delivery: M4A1 (XM-4E1)
Cradle, Rocket Motor, Aerial Delivery: M7 (XM-7)
Box, Shipping and Storage, Rocket Motor Fins: M48 (XM-48)
Skid, 762mm Rocket: M2 (XM-2)
Beam, Hoisting, Rocket: M17 (XM-17)

These items, together with the M33 rocket launcher, the M465 trailer, the M29 tripod hoisting unit, and the M1 rocket delivery basket, made up the Standard A helicopter transportable system. The improved items of handling equipment were to be retrofitted to units already in the field and incorporated in all future production sets.

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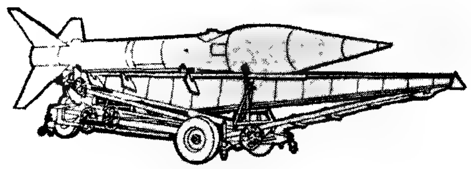
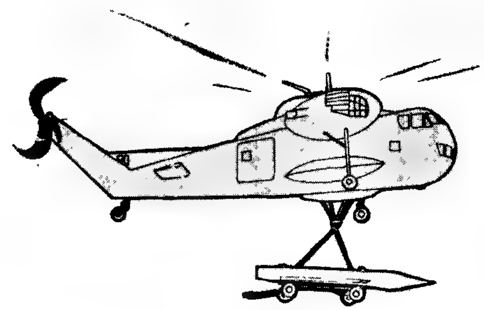
(~~C~~) Aside from the 3 R&D prototypes, 4 pre-production models and 27 LP sets had been produced, 4 of the latter being earmarked for the

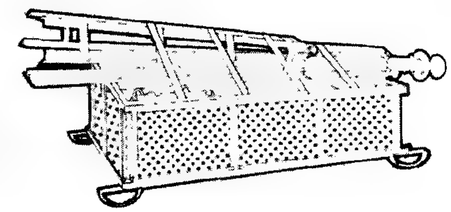
[38] OTCM 37036, 2 Apr 59. RSIC.



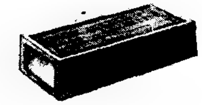
LAUNCHER, 762 MM ROCKET, XM 33



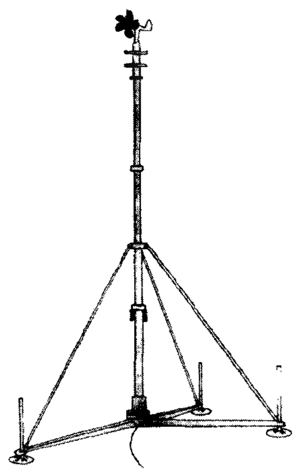
HELICOPTER, H-37



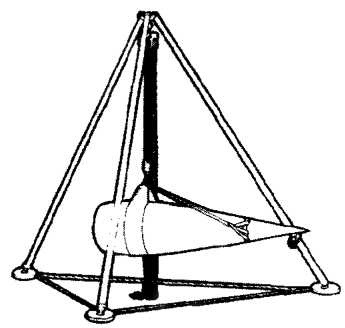
BASKET, DELIVERY, ROCKET EQUIP. M1



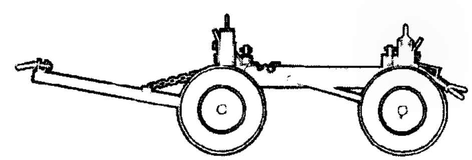
ELECTRIC BLANKET, M2E2



WIND MEASURING SET, AN/PNQ5
(SIGNAL CORPS)



HOISTING UNIT, WARHEAD, XM 32



TRAILER, 762 MM ROCKET, M465

XM-33 LAUNCHER SYSTEM WITH ASSOCIATED EQUIPMENT

ABMA
NO. HJ-113 REV. C
DATE 20 OCT 61

Marine Corps. Procurement plans called for six additional sets to fill Marine Corps commitments. The estimated quantity production cost of one complete launcher set was $80,244, the most expensive items being the M33 launcher ($60,870) and the M465 trailer ($6,900). Two items not included in this cost estimate were the helicopter air delivery sling and the AN/PMQ-6 wind measuring set, the former being supplied by the Transportation Corps and the latter by the Signal Corps.[39]

(U) No further production of the M33 Chopper John was scheduled. The lightweight launcher system had never been intended to supplant the truck-mounted M289 and M386 launchers, but rather to extend the tactical mobility of the Honest John system. The M386 self-propelled launcher, like the M289 that it replaced in September 1957, was designed for transport in Phase III airborne operations. Although specifically designed for helicopter transport, the M33 Chopper John could be used in all phases of such operations. It could be dropped by parachute from a standard cargo plane, and it could be carried inside or slung under an H-37 helicopter. These tactical capabilities were required and, on occasion, would prove highly expedient. But for routine military use, the heavier, self-propelled launcher was more in demand and so was produced in greater numbers.

(U) The standard M33 launcher is about 29 feet long, 7 feet wide, and 4.5 feet high, with a weight of 4,375 pounds. It can be towed by truck on cross-country terrain at speeds up to 5 miles per hour, with or without a rocket. On improved roads, it can be towed at speeds up to 20 miles per hour with a rocket on the launching beam, or at 35 miles per hour without a rocket. The launcher can also be carried on the bed of a 5-ton, long-wheel-base truck. When emplaced, the launcher beam can be elevated between 0 and 62° and traversed 10° either left or right.

[39] OTCM's 37479, 7 Jul 60; 37711, 13 Apr 61.

The minimum beam elevation for firing the M31 series rocket is 10°; and 4° for the M50 rocket.[40]

(U) The XM-33E1 Split-Load Launcher

(U) To demonstrate the feasibility of transporting the new XM-33 launcher by H-21, H-34, or H-37 helicopter, the Ordnance Corps built a split-load version of the launcher in 1959. Designated as the XM-33E1, this model could be split into two helicopter-transportable loads, the launching beam and A-frame making up one load, and the top and bottom carriages the other. Two additional casters were added to the A-frame for this purpose, and a skid bar was connected to the rear of the launching beam.[41]

(U) The feasibility of the split-load launcher was successfully demonstrated in operational and flight tests conducted at the WSMR in July 1959.[42] Following these tests, the CONARC was sold on the idea and briefly considered asking that all XM-33 launchers be converted to the split-load configuration. Representatives of the CONARC, the WSMR, and the BRL, meeting in Washington in October 1959, discussed the advisability of such conversion. They agreed that the 30-round XM-50 firing program, which was to furnish data for the lightweight launcher firing tables, would employ the XM-33E1 model rather than the previously scheduled XM-33.[43] However, a shortage of funds prevented conversion

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[40] TIR 4-2-15A53(4), OCO, Sep 61, sub: Development of 762-mm Rocket Launcher, M33 (XM33), pp. 1-2. RSIC.

[41] Ibid., p. 5.

[42] (1) HJ Prog Rept, Nov 59, ARGMA. (2) ARGMA Diary, 1 Jan - 30 Jun 60, p. 263.

[43] Ltr, USAARTYBD, Ft Bliss, Tex, to Pres, USAARTYBD, Ft Sill, Okla, 19 Oct 59, sub: Trip Rept of Lt Col Kajencki to Washington, D. C. HJ R&D Case Files, Box 13-562, RHA AMSC.

of the launcher in time to meet the firing schedule, and tests of the XM-33 were conducted without retrofit.[44]

(U) The ARGMA Industrial Division released the XM-33E1 split-load launcher for Arctic testing with the XM-50 rocket during the winter of 1959-60. The results of these tests were used as a basis for standardizing the XM-33 launcher, since the dynamics and operational characteristics of the two launchers were, for all practical purposes, identical.[45] Engineering and service tests of the XM-33E1, completed in the spring of 1960, indicated satisfactory performance, but the Ordnance Corps dropped plans for producing the launcher. One outstanding feature of the split-load version was adapted to production models of the M33. It consisted of electrically powered brakes which the driver of the prime mover could operate by remote control when towing the launcher.[46]

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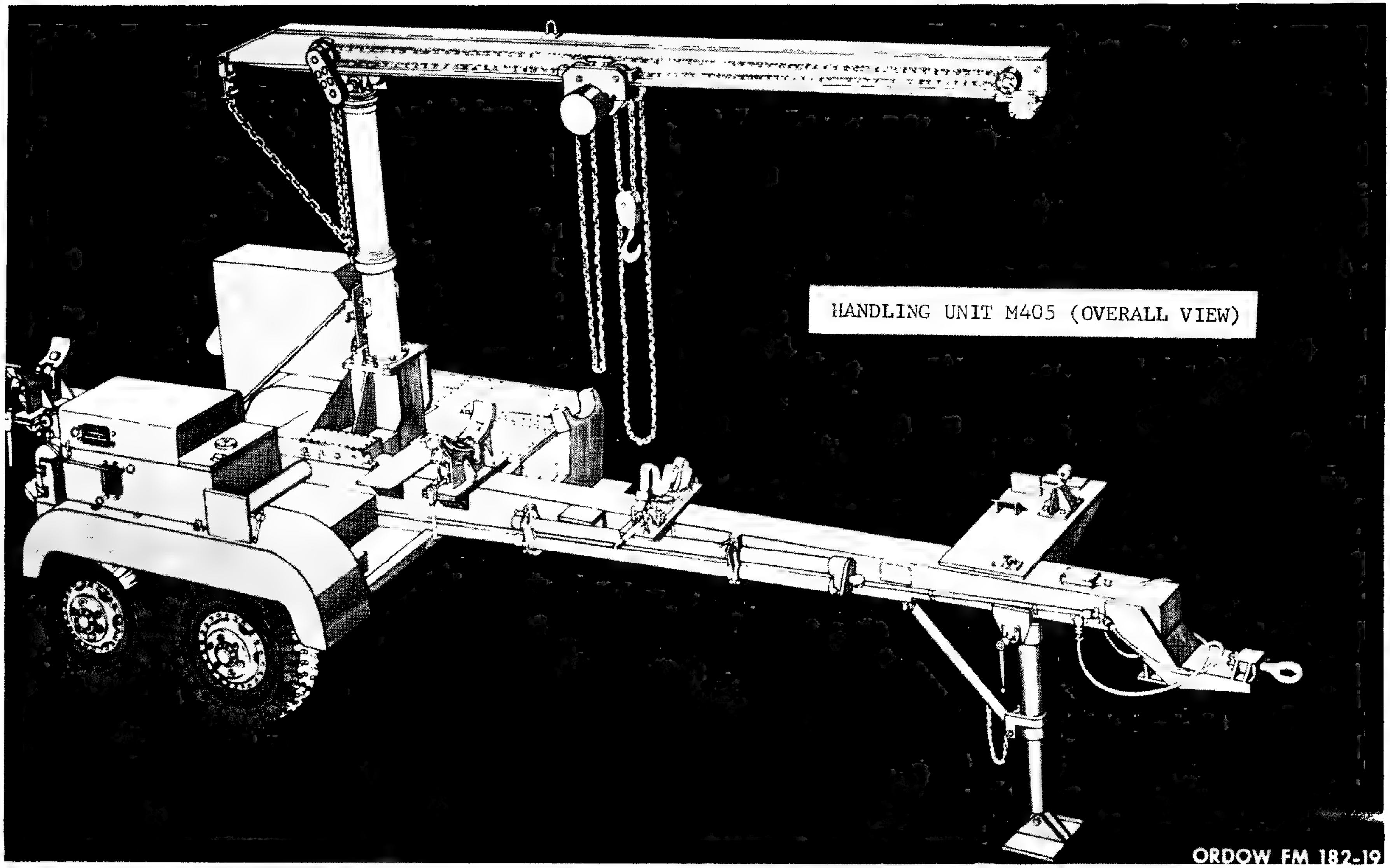
[44](1) DF, Chf, Land Combat Br, PMS, R&D Div, to Chf, Ind Div, ARGMA, 18 Sep 59, sub: XM-33 Lchrs for XM-50, 762mm, HJ, Range Table Firings. HJ R&D Case Files, Box 13-563, RHA AMSC. (2) HJ Prog Rept, Nov 59, ARGMA. (3) ARGMA Diary, 1 Jan - 30 Jun 60, p. 128.

[45]OTCM 37479, 7 Jul 60. RSIC.

[46]TIR-4-2-15A53(4), OCO, Sep 61, sub: Dev of 762-mm Rkt Lchr, M33 (XM33), p. 5. RSIC.

An XM-50 Rocket leaves the XM-33E1 Split-Load Chopper John Launcher in one of three feasibility firings conducted at the WSMR the week of 20 July 1959.


HANDLING UNIT M405 (OVERALL VIEW)
ORDOW FM 182-19

CHAPTER VIII

(U) THE CONTROVERSIAL M405 HANDLING UNIT (U)

(U) Of all the many end items developed under the Honest John Improvement Program, the M405 handling unit was undoubtedly the most expensive and least acceptable. Though developed, produced in quantity, and issued for troop use, it never achieved full user confidence and was eventually replaced in production by the M329A2 pole-type trailer.

(U) Feasibility Studies

(U) Like the M386 and M33 launchers, the M405 handling unit was developed as part of the Honest John Improvement Program initiated in 1955 to improve the tactical suitability of the basic weapon system then in the field. The engineers of Redstone's Ordnance Missile Laboratories pointed to the need for such a device in their preliminary program plan of March 1955. In outlining needed improvements in ground support equipment, they suggested that the M62 wreckers used to pull the XM-329 trailer forward of the Battery Assembly Area (BAA) should be replaced by a general-purpose truck and a simple transfer device. This would not only eliminate many repair problems then being encountered, but would also increase mobility of the system and decrease cost.[1] The Honest John Steering Committee, in mid-March 1955, asked the Rock Island Arsenal to investigate the feasibility of developing an ammunition-handling and loading vehicle[2] for use with the improved launcher.[3]

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[1] RSA Rept 3M51P, 11 Mar 55, sub: Prelim HJ Sys Imprv Prog, p. 6.

[2] The "ammunition-handling and loading vehicle" was referred to in the R&D phase as a transporter-loader, a loader-transporter, and a side-loader. In the production phase, it was called a trailer or a handling unit, and both names persist in field use. The official nomenclature is: Handling Unit, 762mm Rkt, Trailer Mounted, M405.

[3] Min HJ Steering Com Mtg, 16-17 Mar 55. ORDTU File, Jan-Apr 55, FRC.

(U) The Chief of Ordnance was in complete agreement with this approach and actually envisioned an even greater tactical use of the equipment than had been suggested. Referring to the committee's request for a feasibility study, he wrote:

> . . . Successful development of such a vehicle would eliminate many of the present problems connected with the logistic suitability of the system as now designed. If successful, this development would eliminate both the pole trailer XM-329 and the wrecker M62, except as the latter vehicle might be used in the battery assembly area for mating the special warhead to the basic vehicle. This office sees no insurmountable problems in this development and therefore is looking forward to the elimination of the pole trailer and wrecker, at least in the launching area. (Emphasis added.)[4]

(U) Members of the Heavy Rocket Launcher Subcommittee, in late October 1955, adopted the proposed XM-386 launcher for use with the improved rocket system. Since one requirement of the launcher program was the speedy development of a towed, side-loading trailer, they asked the Rock Island Arsenal to give such development precedence over feasibility studies of an end-loading trailer.[5] The Arsenal was to begin fabrication of two launcher sets in January 1956. The schedule called for delivery of the first set with loading unit to the WSPG by 1 August 1956; the second set was to follow the next month.[6]

(U) In March 1956, the Redstone Arsenal ordered a third launcher and loader set from the Rock Island Arsenal and two set specialized for Arctic testing from the Detroit Arsenal.[7] At that time, the design for

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[4]Ltr, CofOrd to CG, RSA, 8 Apr 55, sub: HJ Imprv Prog, RSA Rept Nr 3M51P dated 11 Mar 55. ORDTU File, Jan - Apr 55, FRC.

[5]Work on the end-loader stalled for lack of funds in April 1956 and this concept was later dropped from the program after 95 percent of the components had been designed and ordered. See above, pp. 171-72.

[6]Monthly Prog Rept, Projs TU2-1029 & TU2-3008, 31 Oct 55. ORDTU File, Sep - Dec 55, FRC.

[7]The Redstone Arsenal had overall responsibility for coordinating the improved rocket and launcher programs under Projects TU2-1029 and TU2-3008. The Rock Island Arsenal, through the OWC, had technical supervision of launcher development and the Watertown Arsenal (cont)

the side-loader, now designated the XM-405 handling unit, seemed firm. The OCO had hosted a meeting of interested agencies in November 1955 to finalize the design. The consensus was that a jib crane, mounted on an XM-329 trailer, would best transport the Honest John rocket and transfer it to the launcher. The representatives hedged on earlier predictions for the unit, no longer claiming that the new equipment would replace the M62 wrecker, only that it would reduce the number of such wreckers required with the improved system.[8] The trailer chassis gave no cause for concern, since the XM-329 trailer had already passed transport capability tests. But the addition of the jib crane, which converted the trailer into a handling unit, later became the source of many problems.

(U) The Research and Development Phase

(U) As the fabrication orders went out, the Rocket Branch, OCO, asked for and received an additional $200,000 for the Rock Island Arsenal to build a prototype XM-405 handling unit. Still hopeful that the unit would replace both the wrecker and trailer, the Rocket Branch pointed out that the M62 wrecker had not proven satisfactory under tactical conditions and was actually unsafe under some circumstances, particularly when used to load the rocket onto the launcher with the beam fully extended.[9]

(U) Between January and May 1956, the Rock Island Arsenal built

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[7](Cont) had a sub-responsibility, allied with that of Rock Island, for fabricating specific launcher ancillary equipment (later to include the XM-405E1). The OTAC, and specifically its sub-element, the Detroit Arsenal, performed production engineering throughout the program and had procurement responsibility.

[8]Monthly Prog Rept, Projs TU2-1029 & TU2-3008, Nov 55. ORDTU File, Sep - Dec 55, FRC.

[9]Memo, Chf, R&L Sec, to Chf, Rkt Br, R&D Div, OCO, 23 Mar 56, sub: Funding Status of HJ Imprv & LJ Progs. ORDTU File, Jan - Apr 56, FRC.

the XM-405 handling unit and tested it locally. It redesigned and reworked the R&D models to remedy the deficiencies noted and tested them again before releasing them for further testing at the WSPG. The first XM-405 pilot model reached the proving ground on 20 November 1956, just as the XM-386 launcher tests ended. The launcher was then returned to Rock Island for minor modification. Not until the following spring were the launcher and handling unit tested together.[10]

(U) The CONARC Artillery Board, in the spring of 1957, tested the handling unit with the XM-386, M289, and XM-33 launchers, as well as with the XM-78 heating and tiedown equipment installed on the M55 truck. As expected, the XM-405 handling unit, with or without its A-frame, could do everything the M329 trailer could do. The Board then concentrated on a series of operational tests to determine the superiority of the XM-405 over the M329/M62 wrecker combination. As a result of these tests, the Board recommended that the XM-405 handling unit be standardized, but only after the 13 listed deficiencies were corrected. It specified, however, that the new handling unit should supplement rather than supplant the M62 wrecker. The XM-405 transferred the rocket much more slowly than did the M62 wrecker, the transfer operation requiring between 10 and 15 minutes. The manual power of the unit needed a boost to make it as fast as the electrically powered wrecker. The Rock Island Arsenal then had on its drawing board a chain traversing mechanism improvement, field endorsed, which would reduce the unit's transferral time by 80 percent.[11] In April 1957, the first XM-405 pilot model was returned to the Rock Island Arsenal for correction of noted deficiencies and for the lowering of the unit's reducible height to make it more

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[10] Trip Rept, Larry M. Glasscock to OWC, 31 Oct 62, and incl, "Evolution of the M405A1 Handling Unit."

[11] Ltr, CG, RSA, to CofOrd, et al., 19 Mar 57, sub: Tlr Rkt Hdlg, XM-405, Ord Projs TU2-1029 & TU2-3008, and incl, List of Deficiencies and Suggested Modifications Resulting from R&D Operational Tests of Tlr, Rkt Hdlg, XM-405. ORDTU File, Jan - May 57, FRC.

acceptable for use in Phase I airborne operations.[12]

(U) The Artillery Board later noted that the XM-405 had limited capability for lifting the load, when the monorail was used as a free beam and the chain hoist was used to raise the load. The two factors imposing these limits were distance and angle: the distance between the chain hoist and the travel lock along the monorail, and the angle made by the monorail and the longitudinal trailer axis—in other words, the monorail elevation. When the handling unit operators began to exceed these limits, the XM-405 became unstable and tended to overturn, following the load toward the launcher. Because overturn always threatened when the monorail acted as a free beam, the Board recommended that operators always employ the stabilizing A-frame. Even with the A-frame in use, the unit tended to tip on sloping or slippery terrain. The Board reported, however, that the free beam (monorail) could self-load the rocket motor and then the warhead, from the ground or from an M55 truck when the terrain was level and dry and the A-frame in place.[13]

(U) The CONARC request that the height of the XM-405 be lowered resulted in a major redesign and therefore a new model number. The modified trailer, designated as the XM-405E1, was completed by the Rock Island Arsenal in December 1957 and delivered for service test in early 1958. Following these tests (see photographs), the CONARC recommended that the XM-405E1 trailer, when modified to correct noted deficiences, be type classified as standard, rather than the XM-405. It again specified, however, that the new vehicle should supplement, rather than completely replace, the M329A1 trailer and the M62 wrecker.[14]

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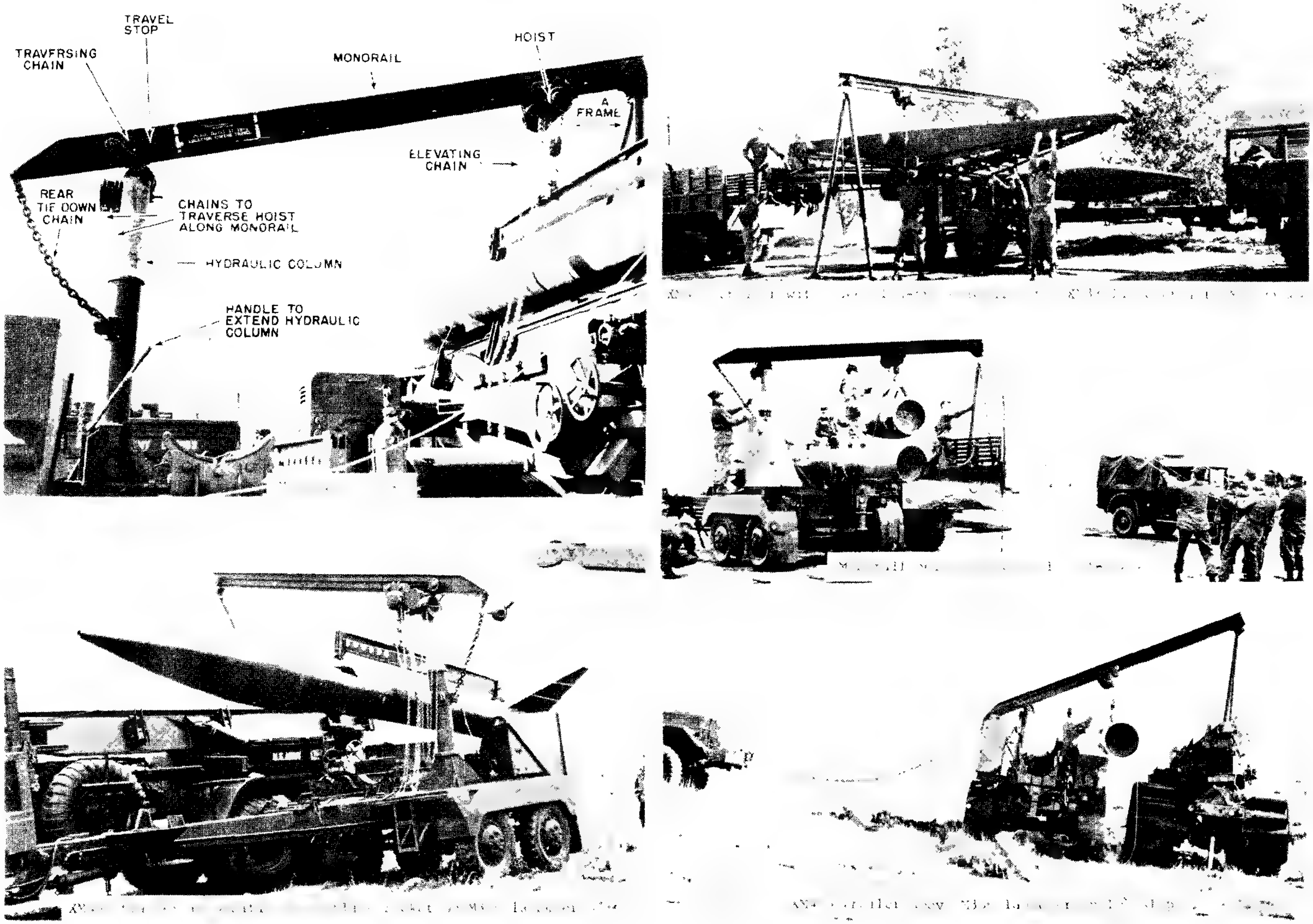
[12] TIR 11-3-6E2, OCO, Jul 58, sub: Development of Trailer-Mounted 762-mm Rocket Handling Unit, M405 (XM-405E1). RSIC.

[13] TT, USAARTYBD to CG, CONARC, 3 May 57. ORDTU File, Jan - May 57, FRC.

[14] (1) USAARTYBD Rept, 24 Feb 58, sub: Proj Nr FA 2257, Svc Test of Tlr, Rkt Hdlg, XM-405. (2) TT, USAARTYBD to CG, CONARC, 24 Apr 58. Both in HJ Cmdty Ofc Files. (3) TIR 11-3-6E2, OCO, Jul 58, sub: Dev of Tlr-Mtd 762-mm Rkt Hdlg Unit, M405 (XM-405E1). RSIC.



Service Test of XM-405 Rocket-Handling Trailer—Fort Sill, Oklahoma, 12 February 1958

U
(~~FOUO~~) Standardization and Subsequent Redesign (U)

(U) On 23 May 1958, the XM-405E1 handling unit was standardized as the M405, with the stipulation that it was a supplement to, and not a replacement for, the M62 wrecker. The M329A1 trailer remained standard, with the M405 replacing it, when required, on a one-for-one basis.[15]

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(~~FOUO~~) With its overall height reduced from 129 inches to 76 5/9 inches, the M405 (XM-405E1) handling unit was transportable in the C119 or the C130 aircraft. A new tilt-table column answered the need for a shorter guidance and traverse column, since the tilt-table permitted lowering the column for transport. The height reduction corrected a major fault and created another. Hinging the hydraulic column at its base allowed it to lie on the trailer, usurping the position intended for the rocket. The operators now had trouble realigning the column, or monorail, to its operational position. An alignment key corrected this difficulty. A come-along device—a ratchet and chain-pulling mechanism—later enabled the operators to position the rocket more accurately and easily on the handling unit itself, as well as on the launcher and M55 truck.[16]

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(~~FOUO~~) As alterations to the M405 design continued, standardization of the unit began to seem premature. From the drawing board to the field, modifications or recommendations for modifications poured in, reflecting a general attitude that the unit was still, unofficially, in the experimental stage. During the summer of 1958, some 3 months after standardization, the Artillery Board reported that 5 of the 13 deficiencies noted the previous year had not been corrected and that others had been only partially corrected. It recommended that the M405's, when

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[15] (1) Ibid. (2) OTCM 36797, 23 May 58. RSIC.

[16] (1) Ltr Rept, USAARTYBD to CG, CONARC, 20 Jun 58, sub: Proj Nr FA 2257-1, Check Test of Tlr, Rkt Hdlg, XM-405E1. (2) Ltr, CG, CONARC, to CRD, DA, 8 Aug 58, sub: Ltr Rept of Proj Nr FA 2257-1 dated 20 Jun 58. Both in HJ Cmdty Ofc Files.

placed in production, incorporate the correction of all 13 deficiencies and, further, that the Artillery Board should test the first production unit to confirm that these deficiencies had been corrected.[17]

(U) Several delaying factors plagued the M405 delivery schedule. The R&D drawings continued to be revised. The component parts frequently arrived late. The lines of communication became hopelessly entangled in overlapping areas of responsibility.[18] Because of the diversity of these contributing factors, the identification of any one source of the mounting troubles became a matter of debate.

(U) The OWC called a conference in May 1958, ostensibly to establish requirements for the overall improved rocket system. The conference soon found itself primarily occupied with the problems of meeting the M405 delivery schedule. The OCO had pointed out to the OWC as early as January 1958 that the choke point in the overall program was the design status of the handling unit. Ordinarily, the standardization, based on a stabilized design, would have removed this choke point. However, dissatisfaction with the unit continued and the design had not yet been released for production. In April 1958 and again in May, just before the conference began, the OCO had requested a speed-up in the production plan to get the equipment to the troops. In answer, the conference agreed, assuming all-out effort, on a target date of November 1958—a compromise between the OCO's first request for launcher system delivery in December 1958 and its current request for an October delivery.[19]

(U) Industrial Production (U)

(U) With standardization of the M405 unit in May 1958, the R&D phase was officially complete. Despite continuing problems of an R&D nature,

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[17] Ibid.

[18] For further details relating to this problem, see above, pp. 40-44.

[19] Ltr, CG, OWC, to CG, AOMC, 19 Mar 59, sub: Delays in HJ Program.

the M405 went into production that summer. On 15 August 1958, Spencer-Safford Loadcraft, Incorporated, signed a contract to produce a pilot model of the M405 handling unit and, following its acceptance, continued production for a total of 128, complete with engineering drawings and technical publications. The contract was later renegotiated for a final total of 210 handling units and drawings, although previous planning had provided for a total of 324.[20] (All other production of the M405 and its successor, the M405A1, took place at the Watertown Arsenal.)

(U) The St. Louis Ordnance District (SLOD) had noted in its pre-award survey report that Spencer-Safford "has production knowledge of this item, having previously produced the same [M329A1 trailer] without the present modification. The contractor has the financial, technical, and production capacity to produce as required." The contractor agreed to a delivery schedule of 2 in November 1958, 4 in December 1958, 10 in January 1959, 18 each 30 days thereafter, through November 1959, and the remaining units in December 1959. At a fixed net price of $1,055,781 for the first 128 M405 units and engineering data, Spencer-Safford had underbid the other two low bidders—the Winter-Weiss Company, also a former M329A1 trailer contractor, and Gremco, Incorporated.[21]

U (~~FOUO~~) Production began slowly. One handicapping factor was the unit's production engineering which, under pressure of time, had to be done concurrently with actual production. Contracting officials had been directed to place this item on contract with R&D drawings and, as one of them later said, "this decision has plagued us ever since."[22] A second handicap was the loss to the industrial production line of the

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[20] Contr DA-23-072-ORD-1341, as amended 3 Apr & 23 May 59.

[21] Ltr, CO, SLOD, to CG, OTAC, 22 Jul 58, sub: Pre-Award Survey Rept on Spencer-Safford Loadcraft, Inc., Augusta, Kansas. (2) DF, Compt Div, OTAC, to Ops Div, OTAC, 25 Jul 58, sub: Concurrence, Proc of Tlr, 762mm Rkt, 4-Wheel, XM-405E1.

[22] TT, CG, OWC, to Ord Off, CONARC, 3 Feb 60. HJ Cmdty Ofc Files.

first pilot model. The OTAC inspectors, in February 1959, had reluctantly accepted the first unit off the production line, listing certain workmanship defects that were to be corrected before further production.[23] The accepted unit was then sent to Fort Bliss, where it was tested by the Artillery Board and given a heavily qualified acceptance. Instead of returning the unit to Spencer-Safford for use as a production model, the Board shipped it to Fort Sill for use in training.[24]

(U) Yet another handicap was the continuing lack of straight-line administration within the Ordnance Corps agencies connected with the M405 program. In February and March 1959, the lines of communication and areas of responsibility for the M405 were a study in overlay.[25] The chief concern of all agencies at the time seemed to be deliveries, with the field forces pushing the OCO for acceleration and the OCO and its sub-elements passing on the pressure. No agency acted to hold back production until a production model had met required standards. The program plan had provided that production would begin at the close of the R&D phase and that full production would follow the Ordnance Corps' acceptance of the pilot model. Thus, the report of acceptance of the first production model, even though carefully qualified, released the industrial production schedules and deliveries began.

(~~FOUO~~ U) Investigation of M405 Production in 1959 (U)

(~~FOUO~~ U) With the first deliveries to the field, complaints began to flow back, triggering an in-house investigation into the industrial program. During a telephone conversation with an OCO official, on

[23](1) OTAC Insp Rept, 5 Feb 59, sub: Min of Pilot Model Insp of M405 Tlr. (2) TT, CO, Detroit Ars, to CO, SLOD, 26 Feb 59. HJ R&D Case Files, Box 13-275, RHA AMSC.

[24]Ltr Rept of Proj Nr FA 2257-2, CG, CONARC, to CRD, DA, 11 Aug 59, sub: Confirmatory Test of Tlr, Rkt Hdlg, M405. File same.

[25]<u>See</u> above, pp. 41-42.

13 May 1959, the Ordnance Officer, USAREUR, asserted that the units were "no good." He followed the talk with a teletype listing 16 deficiencies in units delivered to his command.[26] These deficiencies included poor manufacturing workmanship, inadequacy of the hydraulic system, non-interchangeability of repair parts, improper assembly of commercial components, and lack of instruction manuals.[27]

(~~FOUO~~ U) During the first few weeks of supply, the complaints mounted. The SLOD inspectors sent back for workmanship improvement 16 units which the contractor had declared ready for shipment. Fort Sill reported 9 design deficiencies and 6 manufacturing deficiencies (the latter figure later increased to 13).[28] A special inspection team sent to the Spencer-Safford plant reported finding 23 design deficiencies and 20 workmanship deficiencies. The latter included some defects most often reported by users: ragged welds in several areas, lack of drain holes, and mating holes that would not mate.[29]

(U) Final inspections had become rigid, but complaints continued. On 17 July 1959, the Chief of Ordnance gave verbal directions, later confirmed in writing, for the OWC to stop all M405 handling-unit acceptance pending remedial work by quality assurance personnel then on their way to the Spencer-Safford plant.[30]

(U) The developers were still convinced that most of the deficiencies of a real nature stemmed from bad workmanship rather than any fault in basic design. The fact that the handling unit was manually

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[26] TT, Ord Off, USAREUR, to CofOrd, 13 May 59. HJ R&D Case Files, Box 13-275, RHA AMSC.

[27] OWC Rept, 10 Jul 59, sub: Special Areas Inves by Fld Svc, HJ M405 HU. File same.

[28] MFR, R. D. Backer, 15 May 59, sub: Design and Mfg Deficiencies on M405 Tlr. File same.

[29] TT, CO, SLOD, to CofOrd, 8 Jun 59. File same.

[30] TT, ARGMA Comdr to CG, OWC, 20 Jul 59. File same.

operated and unfamiliar, while the M62 wrecker was power-operated and familiar, was the real source of complaints about the design, they felt. These complaints would cease when the users became better informed and better trained in the use of the unit. Minor design changes seemed necessary, however. The Field Service Division of the OWC planned a mechanical safety device for the hydraulic column and other minor changes.[31]

(U) Official and unofficial conferences at all levels during the first half of 1959 recognized the compounding difficulties within the handling-unit program. The AOMC called a conference with representatives of the OWC and the SLOD, in July 1959, following receipt of this terse message from the Chief of Ordnance:

> As the Honest John Weapon Systems Manager, the responsibility for a complete coordination of all aspects of this problem rests with your Command. . . . A complete coordinated review by your Command is in order to determine what has transpired, what problems remain, and what should be done in the future to prevent recurrence of such a situation.[32]

(U) The ARGMA checked thoroughly that summer the problems found in the engineering, procurement, quality assurance, and field service of the M405 units produced by Spencer-Safford. From the engineering viewpoint, the investigators concluded that the initial production of five acceptable R&D models between November 1956 and January 1959, showed clearly that the engineering drawings were in fact adequate to produce future items equivalent to these R&D models. The Rock Island Arsenal had produced three: serial numbers 1 and 2, tested at the WSPG, and serial number 5, tested in Alaska. The Detroit Arsenal had produced serial numbers 3 and 4, designed for Arctic use. The deficiencies revealed by field tests had been corrected in the design and on all five models, all of which afterward tested successfully. The CONARC

[31] Min of Mtg at SLOD, 28 Jul 59. File same.

[32] Ltr, CofOrd to CG, AOMC, 16 Jun 59, sub: HJ M405 HU. File same.

had then accepted the M405 handling unit for field use.[33]

(U) Answering an ARGMA inquiry, in May, the OWC had reported:

> OWC teams are in action to modify existing handling units in the field at all locations. Teams are presently at Raritan Arsenal modifying the West German shipment, at Fort Sill and [in] Germany, with additional personnel in transit to modify complete stock. . . . All manufacturing deficiencies [at the Spencer-Safford plant] have been corrected and all major operational deficiencies will be corrected by 3 June.[34]

(U) Concerted action by the responsible agencies throughout 1959 resulted not only in higher production standards and smoother production-line operation, but also in greater user-confidence in the M405 unit.[35] An ARGMA team investigating the basic design deficiencies reported that the hydraulic system needed to have increased power to make it as easy to operate as the powered M62 wrecker. The report explained another source of user complaints:

> The basic problem evolves from the fact that the troops have the impression that the M405 trailer will replace the M62 wrecker. The M405 . . . was developed primarily for operations forward of the battery assembly area (BAA). . . . It can be used for general assembly operations when the wrecker is not available.[36]

(U) In addition to the remedial rework on the M405 handling unit, the ARGMA instigated, during 1959, a re-exploration of other transporter-loader concepts. The Rock Island Arsenal engineers proposed an end-loader, supplementing the 1956 design for a unit to replace the XM-405 handling unit during airborne operations. The proposed end-loading unit

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[33](1) Ltr Rept, USAARTYBD to CG, CONARC, 15 Jul 59, sub: Proj Nr FA 2257-2, Confirmatory Test of ... M405. File same. (2) Also see above, pp. 42-43.

[34]TT, CG, OWC, to CG, ARGMA, 22 May 59. HJ R&D Case Files, Box 13-275, RHA AMSC.

[35](1) Ltr, CO, Raritan Ars, to Chf, Ind Div, ARGMA, 15 Sep 59. File same. (2) TT, CG, U.S. 7th Army, Germany, to CG, MICOM, 26 Feb 62. HJ Cmdty Ofc Files.

[36]HJ Prog Rept, Oct - Dec 59, ARGMA.

[redacted]

was helicopter-transportable and the M405 was not.[37] The OTAC reported on a self-propelled loader-transporter, wheeled or tracked, to replace the three-unit combination (the M405 handling unit, the M62 wrecker, and the M78A1 heating and tiedown unit) and possibly to replace the present launcher system. The Ordnance Missile Laboratories reported that such a unit would be more mobile than the M386 launcher.[38] The Army could thus build, at $20,000 each, a unit which would eliminate the need for three major vehicles, and which could transport two rockets and load those rockets in 5 minutes. Neither of these studies was implemented, although both had generated much interest. In the first place, the clamor for replacement had died down and the improved M405A1 unit was reported as generally satisfactory to the user. Secondly, funds were not available for a new R&D phase, and emergency funding could not be sought when an emergency did not exist.[39]

U
(~~C~~) Standardization of the M405A1 (U)

(U) The M405A1 handling unit, with modifications to correct 12 deficiencies in the M405, became Standard A in May 1960, and the M405 was reclassified as Standard B.[40]

U
(~~C~~) During most of 1960, the M405 handling unit was used as a trailer only. In spite of improvements, the rocket load still appeared to be too heavy for the hydraulic system, particularly when the operators attempted to use the unit without the supporting A-frame. The Ordnance Missile Laboratories team approved an OTAC retrofit, designed

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[37] Johnson and Weston, Development and Production of Rocket Launchers at Rock Island Arsenal, 1945 - 1959, II, 203.

[38] DF, Dir, OML, to Chf, R&D Div, ARGMA, 4 Jan 60, sub: Inves M405 Tlr. HJ R&D Case Files, Box 13-275, RHA AMSC.

[39] Johnson and Weston, op. cit., II, 203.

[40] OTCM 37426, 26 May 60. RSIC.

to bring the base of the hydraulic column in complete contact with the trailer. After seeing this retrofit demonstrated at Fort Bragg, the team recommended field and shop modification of all units before further rocket loading. The ARGMA reported the recommendation to the OWC, which then informed all using units that the M405 trailer would be used for transport only until the retrofit was complete.[41]

(U) These lift assembly modifications distinguished the improved M405A1 from the M405 handling unit. The remodeled lift assembly had four new seals, a 4-inch hydraulic cylinder to reduce pressure, a combination pump-relief valve-selector valve to reduce piping, and better assembly procedures to reduce overhaul time. The handling unit's basic military characteristics were not changed.[42]

U
(Ø) In-House Production (U)

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(Ø) By the time the M405A1 became Standard A, the production line had shifted from industrial production at the Spencer-Safford plant to in-house production at the Watertown Arsenal. The original plan had called for 324 units to be manufactured industrially. The first and only industrial contract, signed on 15 August 1958 with Spencer-Safford, was for 128 units and associated material. This contract was later amended to add 82 units, making a final contract total of 210.[43] In September 1959, the OWC gave the Watertown Arsenal an order for 10 M405's to accompany the Marine Corps order for Honest John rocket systems. In March 1960, the Watertown Arsenal received another in a

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[41](1) DF, Dir, OML Div, to Chf, R&D Div, 4 Jan 60, sub: Inves of M405 Tlr. (2) TT, ARGMA to OWC, 27 Jan 60. (3) TT, OWC to all Comds, 28 Jan 60. All in HJ R&D Case Files, Box 13-275, RHA AMSC. (4) Ltr, J. A. Robins to Col H. S. Sundt, USMAAG, Copenhagen, 14 Apr 60. HJ R&D Case Files, Box 13-562, RHA AMSC.

[42]OTCM 37426, 26 May 60. RSIC.

[43]Ltr, CG, AOMC, to CofOrd, 3 Sep 59, sub: HJ M405 HU, w/3 incls HJ R&D Case Files, Box 13-275, RHA AMSC.

series of orders which totaled the entire lot of M405A1's, from pilot model to the program's completion.[44] (The Watertown Arsenal built 231 of the improved handling units before production was canceled in 1963.)

U
(~~C~~) Even with the change in manufacturers, schedule slippage continued, partly because new production of the M405A1 was concurrent with rework of rejected units and modification of returned units. The Watertown Arsenal was to deliver the first 11 M405A1's in February 1961, a schedule based on receiving the OTAC technical data package for the M405, updated to the M405A1 configuration, in May 1960.[45] In November 1960, the Watertown Arsenal informed the AOMC that deliveries would be 60 to 90 days late, because design changes were still being made and only a partial technical data package had been received. The following month the date for delivery of the first 11 units was set up to June 1961.[46] These first deliveries finally took place in July, after hoist modifications had caused further delay.[47] The Arsenal then reported production delays, listing as the contributing causes work overload, lack of funding and personnel, and late receipt of component parts from contractors.[48]

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[44](1) Ltr, CG, OWC, to CG, OTAC, 11 Sep 59, sub: HU, M405. (2) Mfg Work Order, OWC to WA, 17 Mar 60. File same.

[45](1) Min of Conf, 14-15 Dec 59, Deficiencies of M405 HU. (2) Min of Mtg at Detroit Ars, 18 Feb 60. File same.

[46](1) Ltr, CO, WA, to CG, AOMC, 21 Nov 60, sub: Possible Delays in Shipping M405A1. (2) Ltr, CG, OWC, to CG, OTAC, 7 Nov 60, no sub. (3) Min of Mtg at OTAC, 5 Dec 60, M405A1. (4) Ltr, CG, AOMC, to CO, WA, 16 Dec 60, sub: Dlvry Scd, HU, M405. File same.

[47](1) Ltr, CO, WA, to CG, AOMC, 26 May 61, sub: HJ M405A1 Dlvry. (2) TT, CG, AOMC, to CofOrd, 7 Jun 61. File same.

[48](1) TT, CG, OWC, to CG, AOMC, 21 Feb 61. (2) TT, CofOrd to CG, AOMC, 5 May 61. (3) TT, CofOrd to CG, AOMC, 14 Sep 61. (4) Repts, AOMC to OCO, dated 11 Oct, 14 Nov, 12 Dec 61, sub: HJ Wpn Sys Monthly Prog Rept. All in HJ R&D Case Files, Box 13-275, RHA AMSC.

(U) The M405A1 Test Program

(U) In August 1960, the Watertown Arsenal sent the preproduction M405A1 model (serial number 128) to the Aberdeen Proving Ground (APG) for testing. The initial tests, conducted between 12 August and 28 October, concluded with an unsatisfactory report on several characteristics: the reach extension, the hydraulic system's performance at low temperatures, the storage capability, the fire extinguisher system, the basic structural workmanship, and the overload on the tires and the lunette.[49]

(U) The dissatisfaction with the reach extension was not with the reach itself, since no reach problem was yet involved. During the 1958 testing at the WSPG, a break had occurred where the gooseneck connected to the lunette, and a design change had been made to correct any weakness in that spot. The preproduction model's gooseneck then cracked at the bend during the APG tests, after a total of 1,152 road test miles, 250 of them cross-country. Increases in load, associated with the hydraulic system improvements, had contributed to the break. The M329 trailer without rocket had borne 850 pounds; the XM-405, 1,170 pounds; the XM-405E1, 1,320 pounds; and the M405A1, 1,600 pounds. The Watertown Arsenal had used heavier steel in building the improved units, in an effort to correct the weaknesses of earlier models.[50]

(U) On 7 July 1961, the Arsenal shipped the first production M405A1 vehicle to the APG for quality assurance and reliability testing. This unit, serial number 370, was the first tested under the new Detroit Arsenal purchase description, which called for increased duration and degree of testing. It tested generally better than had the preproduction unit, except in cold-room performance and in reach reinforcement.

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[49](1) Ltr, CG, OWC, to CG, OTAC, 29 Jan 61, sub: APG Repts, M405A1. (2) APG Rept, Jan 61, sub: Test of HU ... M405A1 (Prototype). File same.

[50]AOMC Briefing for CofOrd, 11 Jan 62, p. 3. File same.

The test control was marred on 14 August, when the reach assembly was accidentally dropped. No discernible damage resulted. When the reach assembly failed later, after 800 miles of cross-country testing, no one could be sure that this was a true failure; the accidental drop may have contributed to it. Representatives of concerned agencies met at the proving ground on 16 August 1961 to examine the evidence. They sent the broken piece to Watertown for a metallurgical test and directed that another production vehicle be sent to the proving ground for a check test.[51] The OWC then directed the Watertown Arsenal to hold shipments of M405A1 units, pending an analysis of the third test.[52]

(U) The Arsenal selected serial number 333 for testing, then conducted repeated 12-inch drops of the unit, going beyond the engineering requirements for such tests. Representatives of the AOMC, the OWC, the OTAC, and the APG, meeting at the Watertown Arsenal on 30 August 1961, recommended that the Arsenal discontinue the drop tests and perform strain tests on the unit, then ship it to the APG for routine testing. The strain tests failed to reveal any drop damage, and the OWC directed the Arsenal to resume production and delivery.[53]

(U) Instrument difficulties delayed the APG tests on serial number 333 until the end of October. The unit passed the OTAC-prescribed test drops of from 6 to 30 inches with no apparent cracking. On 15 November 1961, however, after 716 cross-country miles, such severe cracking occurred that the unit could not be used. The cause of the failure was questionable. Was the reach assembly unsatisfactory? Or had the deliberate dropping—much more severe than the single accidental drop—damaged the assembly before the test? The third test, like the second, was inconclusive. The OWC again directed the Watertown Arsenal to suspend further shipments of the M405A1 unit until further notice, but

[51] TT, CG, OWC, to ABMA Comdr, 24 Aug 61. File same.

[52] TT, same to same, et al., 25 Aug 61. File same.

[53] TT, CG, OWC, to ABMA Comdr, 21 Sep 61. File same.

to continue producing all components except those related to the reach assembly.[54]

(U) During a meeting later held at the APG, representatives of interested agencies agreed that the reach design must still be considered marginal. The OTAC directed the Watertown Arsenal to rework serial number 333 at the proving ground, rather than return it to the shop. A gusset extension with a superimposed 76-inch plate repaired the crack at the critical area.[55]

(U) On 29 November 1961, the repaired M405A1 (#333) was ready for cross-country test, no further drop tests being planned. The test was again stopped on 1 December, when the cracks became so enlarged after 262 additional cross-country miles that continuation meant certain failure.[56] In early December, representatives of OTAC, OWC, and AOMC met at Watertown and there agreed on a planned fix that the Arsenal was to install before further testing. The fix was a "wrap-around," a U-shaped piece of quarter-inch steel, 12 feet long, superimposed on the reach assembly for its reinforcement. The Arsenal modified one M405A1 handling unit (serial number 378) with the wrap-around fix and shipped it to the APG on 13 December 1961.[57]

(U) Test 4, with unit #378, began on 14 December 1961—a road test only, over 1,800 cross-country miles. Meeting on 18 December, the OWC, OTAC, and AOMC representatives again concluded that the reach design was "very marginal" and that the M405A1's then in production would have to be modified to strengthen the reach assembly. They recommended that the test be extended to include the excessive stress of road stops at 38 miles per hour, to see if the wrap-around fix would eliminate

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[54]TT, CG, OWC, to CO, WA, 15 Nov 61. File same.

[55]AOMC Briefing for CofOrd, 11 Jan 62, p. 8. File same.

[56]TT, CG, OWC, to ABMA Comdr, 1 Dec 61. File same.

[57]ABMA Semiannual Hist Sum, 1 Jul - 11 Dec 61 (2 vols), I, 128.

the deficiency. This extended testing was to be conducted before incorporating the fix into the production design or releasing it for field retrofit.[58]

(U) In January 1962, as unit #378 completed 1,935 miles of the now projected 2,000-mile cross-country test without incident, the agency representatives met again and agreed that the wrap-around fix corrected the deficiency satisfactorily. The OWC then directed the Watertown Arsenal to proceed with production and delivery, incorporating this fix on all M405A1 handling units.[59] The new design increased the steel thickness from 3/16 to 1/4 inch and minimized weld problems and stress concentration. The last 100 units on the existing order were to incorporate the new design. In addition, the Arsenal prepared field modification kits at an estimated cost of $300—$100 for fabrication and $200 for field modification.[60]

(U) Test 5, with two M405A1 units, began in February 1962 at the APG and continued for several months. Unit #425, the old M405A1 design with a wrap-around fix, and #525, built with the newly designed reach assembly, were scheduled for 2,560-mile tests: 1,000 level miles; 1,000 highway miles; 500 hilly, cross-country miles; and 60 Belgian block testing miles. Later, the final total in test miles was raised to 4,000.[61]

(U) The scheduled tests ended in May 1962 with no more planned. The Watertown Arsenal, which had taken over the engineering tasks for the M405A1 handling Unit, was then completing the technical data package. It was experimenting with various pumps to improve the operation of the

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[58] AOMC Briefing for CofOrd, 11 Jan 62, p. 10. HJ R&D Case Files, Box 13-275, RHA AMSC.

[59] _Ibid._, p. 11.

[60] _Ibid._, p. 12.

[61] Ltr, CG, AOMC, to CofOrd, 8 Mar 62, sub: HJ Wpn Sys Monthly Prog Rept for Feb 62. File same.

hydraulic system at low temperatures. In June, the Arsenal experimented with an MPD 206 hydraulic fluid, which was showing promise at $-65^{\circ}F$. when used in conjunction with an enlarged suction conduit and filter.[62] It asked that the M405A1 units #425 and 525 be held at the APG until all planned tests were complete, and that #370 remain at the Arsenal indefinitely for continued cold-room and other tests.[63]

(U) Meanwhile, the APG had begun the additional 1,000-mile testing of units 425 and 525 in April and May, a test to destruction designated as Test 6. These two handling units had proved equally satisfactory. Either with field modification or with the new built-in reach design, the M405A1 unit was structurally adequate.[64] The Army Missile Command (MICOM) planned to modify the units in the field only on demand. The authorized field modifications included making the hydraulic system operable at extremely low temperatures, installing the improved parking brake system for steep-grade holding, and correcting the jacking facilities to allow the exchange of wheel assemblies.[65]

(U) Congressional Investigation of the M405 Program (U)

(U) The M405 handling unit was the subject of a full-scale investigation by the General Accounting Office (GAO), which began its probe of the program as early as 1960. The Army Missile Command received a draft copy of the report in September 1963. The Army Materiel Command

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[62](1) Ltr, CG, AOMC, to CofOrd, 7 Jun 62, sub: HJ Wpn Sys Monthly Prog Rept for May 62. (2) Ltr, same to same, 5 Jul 62, sub: HJ Wpn Sys Monthly Prog Rept for Jun 62. File same.

[63]TT, CG, OWC, to CG, AOMC, 28 Jun 62. File same.

[64](1) APG Rept Nr DPS-574, Jun 62, sub: Test of 2 HU's, 762mm Rkt, Tlr-Mtd, M405A1. (2) TT, CG, AOMC, to CG, OWC, 21 Jun 62. File same.

[65](1) Hist Rept, D/P&P, MICOM, Jul - Dec 62. (2) Ltr, CG, AOMC, to CofOrd, 5 Jul 62, sub: HJ Wpn Sys Monthly Prog Rept for Jun 62. HJ R&D Case Files, Box 13-275, RHA AMSC.

directed the MICOM to take the necessary actions to review and evaluate the report.[66] This evaluation was an appendix to the final GAO report, submitted to the Congress the following spring. The final report stated:

> The Army procured M405 and M405A1 rocket-handling units at a cost of about $10.4 million which, according to available information, did not significantly improve the capabilities of the Honest John rocket system and are acknowledged to be incapable of performing the job for which they were originally intended. The Army could have purchased a similar number of M329 trailers at a cost of about $3 million. The Army had sufficient information available before production showing that the M405 would serve only as an expensive replacement for the M329 trailer and that the M62 wrecker already in use would continue to be required for rocket handling. The Army had knowledge that introduction of the M405 into the Honest John rocket system did not reduce the time of loading operations and that numerous design deficiencies existed. The need for a new concept was recognized by the Artillery Board immediately after R&D tests were performed.
>
> . . . Even though many modifications were subsequently applied to the M405 and the M405A1, the modifications have not eliminated the excessive loading time and the restrictions on use under adverse conditions of weather and terrain.[67]

(U) The GAO recommended that the Department of the Army maintain continuous surveillance over future development and procurement; that development and procurement directives hold the procurement agency accountable for attaining specific results; and that the Department consider canceling its current plans to produce additional M405A1's at the Watertown Arsenal and produce instead a similar quantity of M329A1 trailers.[68]

(U) The DA reply, based on the draft report, stressed that, before

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[66]Ltr, CG, AMC, to CG, MICOM, 10 Sep 63, sub: GAO Draft Rept on Unnecessary Costs Incurred in the Proc of the M405 Rkt HU. GAO Rept File, HJ Cmdty Ofc.

[67]Comptroller General Report to the Congress of the United States, 31 Mar 64, sub: Unnecessary Costs Incurred in the Procurement of the M405 Rocket Handling Unit. File same.

[68]Ibid.

and during the time that the M405 was being designed, developed, and produced, the field army concept was extremely fluid, with particular emphasis on dynamic tactical doctrine. The power-packed Honest John rocket system offered great power only if speed and mobility were added to keep it in operation during actual battle conditions. The Department of the Army had realized, at the time the M405 handling unit went into production, that the M62 wrecker would remain the primary rocket-loading vehicle. The M405's superior mobility advantages in the forward battle areas, however, had justified the production order. The deficiencies revealed in the R&D tests had been essentially corrected. The final testing had revealed no serious operational difficulties other than the human reluctance to favor manually-operated equipment, such as the M405, over a power-operated vehicle, such as the M62 wrecker. The deficiencies showing up later were corrected either in manufacture or by modification work orders or modification kits.

(U) The Department of the Army denied, in its reply to the charges, that the M405A1 handling unit was a marginal item of equipment:

> The M405A1 is capable of performing all intended design functions (uncrating, assembling, transporting and loading, either version of the Honest John rocket on the M289, M386 or the M33 launchers) and emergency missions without the use of the M62. . . .
>
> The M405A1 can be used with the M33 Lightweight Launcher to gain a Phase I and II air transport capability. This capability has not been fully exploited since the Little John system has replaced the Honest John in the Airborne Division.
>
> The M405A1 is currently recognized by theater commanders as providing tactical flexibility, a necessary complement to the M62, and a replacement for the M62 in certain tactical situations.[69]

(U) With reference to the Comptroller General's recommendations, the Department pointed to recent management improvements through

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[69] Ltr, DCSLOG to Honorable Joseph Campbell, Compt Gen of the U. S., 6 Nov 63. App II, Compt Gen Rept, 31 Mar 64, file same.

adoption of the Project Manager concept and to various formal procedures designed to provide adequate documentation in support of major program decisions. The Armed Services Procurement Regulations, the reply noted, contained contractual procedures that fixed responsibility and provided for production rewards and penalties.[70]

(U) Cancellation of M405 Production (U)

(U) The recommendation that further production of the M405A1 handling unit be canceled had already been implemented when the formal DA reply was prepared. The 210 M405 units produced by Spencer-Safford had all been delivered by the end of FY 1960, complete with engineering drawings and publications. The Watertown Arsenal had produced 10 M405's for the Marine Corps and 221 M405A1's, completing this production in July 1962.[71] Of the M405/M405A1 units produced, the Army received 215; the Marine Corps, 10; and MAP customers, the remainder.[72] The FY-1964 program, which included the previous fiscal-year carryover, called for the Watertown Arsenal to produce 24 more M405A1's, 19 for the Army and 5 for MAP customers. This procurement was suspended in September 1963 and officially canceled in November.[73] The Army Materiel Command later authorized the procurement of 24 M329A1 trailers to fill these orders.[74]

(U) Early in 1964, the Army Materiel Command reclassified the

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[70] Ibid.

[71] TT, CG, OWC, to CO, RIA, et al., 6 Jul 62. [The GAO final report gives the total Watertown Arsenal production as 226, apparently adding the 5 test models.]

[72] AMP FY 1963-70, Msl Sys (Vol II), Jan 64 draft, p. 227. HJ Cmdty Ofc Files.

[73] (1) WO, CG, MICOM, to CO, WA, 16 Sep 63. (2) WO, same to same, 19 Nov 63. (3) WO, CG, MICOM, to CG, MOCOM, 30 Dec 63. File same.

[74] TT, CG, AMC, to CG, MICOM, 21 Apr 64. HJ R&D Case Files, Box 13-275, RHA AMSC.

M329 and M329A1 trailers from Limited Standard to Standard B.[75] The Army Tank-Automotive Center reworked the trailer documentation for compatibility with the M50 rocket series. Modifications accompanied the M329A1 trailer production to such an extent that an improved M329A2 version was already a fact, although not yet standardized.[76]

(U) Although plans called for no further production of the M405 series handling unit, those already produced were to be used as long as they remained in serviceable condition.

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[75] AMCTCM 2233, 28 Feb 64. RSIC.

[76] MICOM Annual Hist Sum, 1 Jul 63 - 30 Jun 64, pp. 116-17.

HONEST JOHN DEPLOYMENT

CHAPTER IX

(U) HONEST JOHN DEPLOYMENT (U)

(U) Throughout the 15-year history of the Honest John Project, the primary mission responsibility rested with Army elements located at the Redstone Arsenal, transferring from the Arsenal itself to the AOMC and its subordinate element, the ARGMA, in 1958; briefly then to the ABMA, in 1960; back to the AOMC headquarters, in late 1961; and finally, in 1962, to the reorganized Army Missile Command headquarters. This mission responsibility extended from the early feasibility studies through many areas of research and development, production, testing, training, and maintaining the system's military readiness after deployment.

(U) Personnel Training

(U) Although the improved Honest John system did not reach the field as a complete tactical unit until May 1961, the training of personnel to operate and maintain it necessarily began several years earlier. Consisting essentially of revised or up-dated courses previously taught on the basic Honest John system, the program included new equipment training and resident training for both Ordnance and user personnel. The Ordnance Corps plans did not provide for special unit training on the improved system. Instead, individuals were trained to replace personnel in existing Honest John units or to become members of new units.

(U) New equipment training courses on both the basic and improved systems were conducted by the Army Ordnance School at Aberdeen Proving Ground, Maryland. This consisted of the initial transfer of knowledge of the system from the developing agencies and contractors to key civilian and military personnel of both Ordnance and the user, members of both groups attending the same courses. New equipment training

courses on the M386 launcher were conducted by the Maintenance School at the Rock Island Arsenal.

(U) Resident training of individuals and units for Ordnance support in the field was conducted by the Ordnance School at Aberdeen. Ammunition inspectors selected to attend these specialist courses received initial support training at the Redstone Arsenal and the White Sands Missile Range. The Artillery and Guided Missile School at Fort Sill, Oklahoma, conducted resident training courses for individuals and units to be activated by the CONARC as Honest John firing battalions. The instructors for the resident courses at Fort Sill received their training on the system in the aforementioned new equipment courses at Aberdeen and Rock Island.[1]

(U) <u>Training Concepts</u>

(U) Generally, training courses on the Honest John weapon system embraced five echelons of maintenance as outlined in AR 750-5 and prescribed in specific DA technical manuals. They were operational and organizational maintenance (1st and 2d echelon), taught in resident courses at Fort Sill, Oklahoma; field maintenance (3d and 4th echelon), taught at the Ordnance School; and depot maintenance, provided by responsible agencies at the appropriate time.

(U) Operational and organizational maintenance service is performed by the operator or crew and by specially trained mechanics within the Honest John field artillery rocket battalion. Field maintenance incorporates the service performed on Ordnance equipment by mobile and semi-mobile Ordnance maintenance units and Post Ordnance Shops. Depot maintenance embraces the repair of materiel requiring major overhaul

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[1] HJ Msl Sys Plan, ARGMA MSP-11, 1 Jun 60, pp. 1G-2G. (2) Tech Rept, Ordnance Guided Missile and Rocket Programs, Vol V, Honest John, Inception through 30 June 1955, pp. 114, 128, 145. (The latter document hereinafter identified as: HJ Blue Book.)

or complete rebuild of parts, subassemblies, assemblies, and/or the end items. It augments stocks of serviceable materiel and supports lower echelons of maintenance by the use of more extensive shop equipment and personnel of higher technical skill than are available in organizational or field maintenance activities.[2] Trained ammunition specialists are geographically located at Ordnance class II storage depots throughout each of the Army areas and are available for assistance to combat units.[3]

(U) New Equipment and Resident Training

(U) New equipment training on the M386 launcher was completed by Rock Island Arsenal's Maintenance School in the last quarter of FY 1959. A total of 135 Ordnance and user personnel were trained in the operation and maintenance of the improved launcher and returned to their home stations with sufficient equipment and training aids to prepare and conduct the required resident training.

(U) The first new equipment class on the XM-50 rocket and M405 trailer began at the Ordnance School in early February 1960 and was completed some 2 months later. A total of 107 key instructor and maintenance personnel completed the course, adding the information received to existing Honest John resident training courses already set up at the Ordnance School and the Artillery and Guided Missile School at Fort Sill.

(U) As soon as the new equipment courses were completed, the Ordnance School began resident training classes in 3d and 4th echelon maintenance for Ordnance support personnel. These revised or up-dated courses included changes introduced into the Honest John system by the XM-50 rocket, the M386 launcher, and the M405 trailer. Similar resident

[2]HJ Msl Sys Plan, ARGMA MSP-11, 1 Jun 60, pp. 7F, 3G.

[3]HJ Blue Book, pp. 114-15.

courses in 1st and 2d echelon maintenance for user personnel were conducted by the Artillery and Guided Missile School as required to meet deployment schedules.[4]

U (S) Field Support (U)

U (C) Supply and Maintenance Concepts (U)

(U) Essentially the same field support doctrine was applied to both the basic and improved Honest John weapon systems. The logistic plan for both systems was based upon the responsibilities and policies prescribed in the following field manuals (FM's) and Army regulations (AR's).

FM 9-5, Ordnance Maintenance in the Field
FM 9-6, Ordnance Ammunition Service in the Field
FM 9-10, Ordnance Maintenance and General Supply in the Field
AR 370-3, Military Publications Preparation and Processing
AR 700-18, Repair Parts Allocation and Allowance
AR 700-19, Provisioning of Repair Parts
AR 750-1, Concepts of Maintenance
AR 750-5, Maintenance Responsibilities and Shop Operations
AR 750-6, Maintenance Planning, Allocation, and Coordination
AR 750-912, Technical Assistance in Maintenance of Ordnance Equipment
AR 750-970, Ordnance Field Maintenance Shops and Missions
Policy Guidance for Ordnance Support of Guided Missile Systems

(U) The various end items, components, and assemblies making up the complete tactical system are assigned to different commodity groups and supplied to the field through specified supply channels. The major items required to assemble a complete Honest John round, including associated warheads, are considered ammunition items assigned to the "S" group and as such are requisitioned and supplied through normal Class V ammunition channels. Special weapons materiel for the Honest John system is the responsibility of the Army Munitions Command (MUCOM).

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[4] HJ Msl Sys Plan, ARGMA MSP-11, 1 Jun 60, pp. 1G-4G.

Non-explosive repair parts for the rocket are Class IV items supplied through general supply channels and are listed in various Standard Nomenclature List (SNL) groups: i.e., H, Y, etc. The launchers and handling equipment are general supply materiel assigned to the "D" group and are the responsibility of the Army Weapons Command (WECOM). Special tools and tool sets for all Ordnance general supply items are assigned to "J" group. The Directorate of Supply and Maintenance (formerly the Field Service Division) of the MICOM has responsibility for national stock control and maintenance functions for items in the SNL "Y" and "S" groups and for special rocket tools in SNL "J" group.

(U) The maintenance plan for the Honest John system was formulated under provisions of AR 750-1, 750-5, and 750-6. The five echelons of maintenance described above are generally applicable, but actual assignments of maintenance operations were based on the merits of each individual case. Repair parts, supply manuals, and technical manuals were made available to Honest John units in the field, along with trained Ordnance support personnel.[5]

(U) In general, the Direct Support Ordnance Units are equipped with a mobility equivalent to that of the tactical units serviced. They perform repair in the field under combat conditions and provide a single source of maintenance and Class IV supply. Unserviceable materiel not immediately repairable, either for want of time, tools, skills, or volume, is evacuated to the Ordnance General Support Units to the rear. Functions of the latter embrace all assistance required within the combat zone to back up the Direct Support Units.

(U) To facilitate maintenance and test operations, rocket components are packaged in a minimum number of containers. (The M31 series rocket is packaged in three containers, i.e., warhead assembly, rocket motor, and fins; while the M50 comes in only two, the rocket motor and

[5]HJ Msl Sys Plan, ARGMA MSP-11, 1 Jun 60, pp. 1F-2F.

fins in one and the warhead assembly in the other.) Complete-round rockets are issued to troops from Ordnance Special Ammunition Supply Points within the combat zone. These Special Ammunition Supply Points are backed up by ammunition supply battalions located in the army service area of the combat zone.[6]

U (~~S~~) Aside from the expendable rocket, the equipment of one tactical Honest John system consists of a launcher (M289, M386, or M33), a wind measuring set, a wrecker, two handling units, and two heating and tiedown kits. An Honest John firing battery consists of a basic load of 16 rockets, 16 heating blankets, 4 launchers, 4 wind sets, 4 wreckers, 8 handling units (or M329A1 trailers), 8 heating and tiedown kits, and 2 generator sets.[7]

U (~~S~~) <u>Supply of Standard Ground Equipment</u> (U)

(U) By the end of 1962, Army artillery battalions in the United States and in overseas commands had been equipped with the improved Honest John system and were fully operational. No further procurement of major items of ground equipment was planned; however, production of repair parts and replenishment items would necessarily continue as long as the Honest John remained in field use. In 1964, almost all major items of equipment ever built for the basic and improved systems were still in use and giving good service. The two main exceptions were the M139F truck used as the M386 launcher chassis and the M405 series handling unit.

(U) The standard M139 5-ton truck was basically a dependable, versatile vehicle which had given good service with the Honest John system for a number of years, the M139D model having served as the

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[6] Ibid., pp. 2F-3F.

[7] HJ Comd Prog Presentation, AOMC Hq, 14 Aug 61. HJ R&D Case Files, Box 13-275, RHA AMSC.

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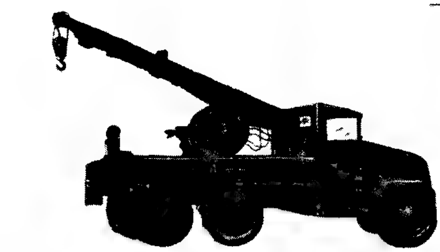
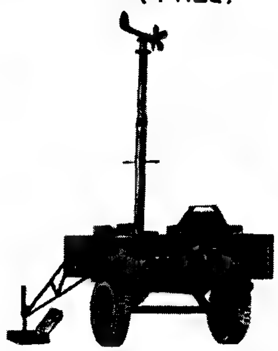
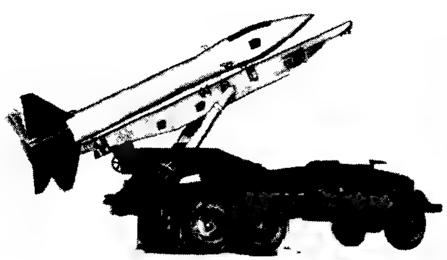
HONEST JOHN FIRING BATTERY COMPONENTS



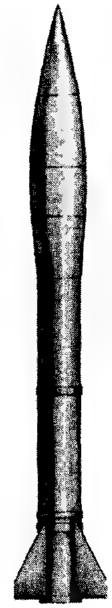
WRECKER, 5 TON, M-62
(4 REQ)



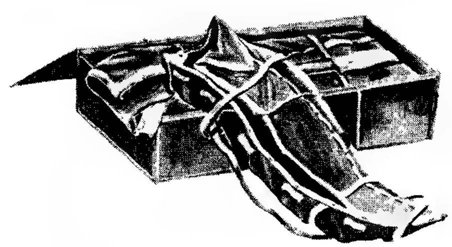
WIND MEASURING SET, AN/MMQ-1B
(4 REQ)



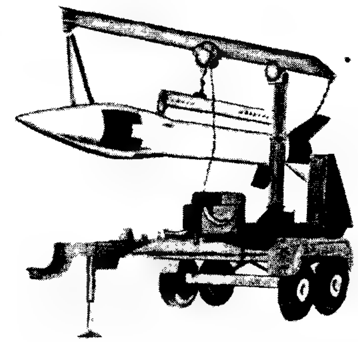
M-386 LAUNCHER MOUNTED ON
5 TON 6X6 TRUCK
(4 REQ)



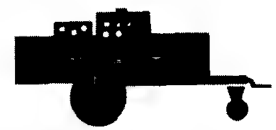
762 MM ROCKET
(16 REQ)



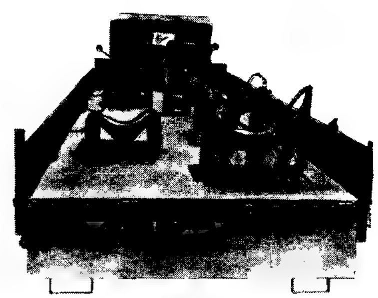
ELECTRIC BLANKETS
(16 REQ)



HANDLING UNIT, TRAILER M-405
(8 REQ)



GENERATOR SETS-GASOLINE
ENGINE M-25-C
(2 REQ)



5 TON TRUCK- M-55
(8 REQ)

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NO HJ-116 REV
DATE 1 NOV 60

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chassis for the M289 launcher and the M139F as the M386 launcher chassis. Most of the M386 launchers, with their gasoline-powered chassis, continued to give satisfactory service until April 1964, when the WECOM reported an equipment breakdown threat in Seventh Army units (Europe). From a sampling of equipment in those units, the WECOM estimated that 75 percent of the M139F chassis frames were cracked to some degree. A follow-up survey made by the MOCOM appeared to substantiate this estimate. The investigating team reported that the cracking had occurred on chassis frames subjected to cross-country hauls, but that other factors had aggravated the frame damage; viz., the launcher's peculiar load distribution, metal fatigue, and welding performed on the tempered steel frame.

(U) Discussions of the breakdown threat in subsequent intercommand conferences led to the conclusion that complete replacement of the chassis was the only logical solution. To insure sustained materiel readiness for current and future military requirements, the MICOM, in December 1964, recommended that the M139F chassis of the M386 launcher be replaced by the M139A2F model with an improved multi-fuel engine.[8] The Command requested procurement authority for 106 of the M139A2F's, but only 1 prototype had been approved as of early June 1965.[9]

(U) For reasons already enumerated, the M405A1 handling unit was replaced in production by the standard M329A1 trailer in November 1963. Although not programmed after 1963, the M405 series handling unit remained in field use with the M329A1 trailer and the M62 wrecker.[10]

(~~C~~ U) At the peak of Honest John field activity in the early 1960's, the Ordnance Corps was providing supply and maintenance support for

[8](1) DF, Dir, S&M, to HJ Cmdty Ofc, 7 Dec 64, sub: Mat Readiness of the M386 HJ Lchr; and incl, Min of Meeting. (2) Ltr, DCG, LCS, MICOM, to CG, AMC, 9 Dec 64, sub: same.

[9]Data provided by HJ Cmdty Ofc, MICOM, 11 Jun 65.

[10]See above, pp. 258-59.

Honest John Firing Area 39, Vilsick, Germany - 1963

some 369 launcher systems—97 M289's, 235 M386's, and 37 M33 Chopper Johns. Most of these systems were tactically deployed outside the Continental United States (CONUS) in U. S. and NATO commands.

(U) The M289 launcher system had remained in Army use as Standard A until September 1957, when it was replaced by the improved M386 launcher and reclassified as Limited Standard type.[11] By 1962, it had been phased out of active U. S. Army units and reissued to MAP (NATO) units. Four M289 launchers were returned to the Army by a MAP customer in early 1965. The Army sold one of these to another MAP customer and cannibalized one to rebuild the other two, reducing the number of serviceable launchers from 97 to 96. The two rebuilt launchers were issued to Honest John units at Fort Lewis, Washington, and Fort Hood, Texas, for use in training.[12]

(U) Virtually all of the M386 launcher systems remained in active service with U. S. and NATO forces, only one being dropped from accountability as unserviceable. In contrast, only 19 of the 37 M33 launchers were still carried in the Army's inventory as of June 1965. Eight of these were assigned to U. S. Army units (4 in USAREUR and 4 in USARPAC); 10 were turned in by the Marine Corps in 1964 and reissued to National Guard units; and 1 was undergoing repair at the Rock Island Arsenal. Of the remaining 18 M33 launchers, 9 were scrapped and 3 were dropped as unserviceable at the Watertown Arsenal; 1 was placed on display at the Senior Officers' Preventive Maintenance School, Fort Knox, Kentucky; 2 were sent to Germany for display purposes; 2 were dropped as unserviceable at the Rock Island Arsenal; and the whereabouts of the other was unknown.[13]

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[11] OTCM 36609, 12 Sep 57. (Also see OTCM's 37119, 15 Jul 59; 38118, 13 Aug 62; and AMCTCM 2233, 28 Feb 64.) RSIC.

[12] (1) HJ Comd Prog Presentation, AOMC, 14 Aug 61. (2) Intvw, Elva McLin with Herman L. Martin, HJ Cmdty Ofc, 17 Nov 64. (3) HJ Inv & Deployment Status, Jun 65, Dir, S&M.

[13] Ibid.

U (~~S~~) Procurement and Supply of Ammunition (U)

U (~~S~~) The improved XM-50 rocket (less warhead) was released for initial quantity procurement as LP type in September 1959. Because of continuing technical problems with the rocket motor, it remained in that category for the next 3 years. From FY 1960 through FY 1963, the Department of the Army procured 6,347 LP-type rockets, along with 2,176 XM-38 practice warheads and 1,200 T2044 HE heads. The Army General Staff approved the reclassification of the rocket from LP type (XM-50) to Standard A type (M50) in December 1962. Subsequent procurement of standard M50 rockets (less warhead), in FY 1964 and FY 1965, totaled 742 rounds. Of the 7,089 LP and standard rounds produced, 4,503 went to U. S. Army artillery units; the remainder went to MAP and other customers.[14]

U (~~S~~) Initial industrial deliveries of the XM-50 rocket (less warhead) began in May 1961, the first available lots being shipped directly from the Radford Arsenal to the USAREUR and the Blue Grass Ordnance Depot.[15] For practice and training purposes, the Army used an inert loaded XM-50 system. Each Honest John battalion was issued two inert XM-66 rocket motors with electrical checkout capabilities and two inert XM-38E1 flash-smoke warheads. The new XM-38E1 practice head simulated the T2044 HE head and provided troops with a less expensive practice warhead for field training in handling and firing procedures. The interim practice head used with the M31 series rocket was not compatible with the XM-50 configuration.[16]

U (~~S~~) The interchangeable T2044 HE warhead section (standardized as the M144) had been developed to replace the M6 head which was compatible

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[14] See above, pp. 152-67.

[15] (1) HJ Prog Rept, ABMA, May 61, p. 4. (2) TT, CG, AOMC, to CofOrd, 16 May 61.

[16] (1) TT, Comdr, ABMA, to CINCUSARPAC, 13 Nov 61. (2) HJ Msl Sys Plan, ARGMA MSP-11, 1 Jun 60, p. 17D.

only with the M31 series rocket. With the gradual phase-out of the M31 rocket, a number of tactical warheads (including the M6, the T39, and the T2043) would become obsolete. The 1961 year-end assets, continuing through FY 1967, were expected to include 1,759 M6 heads at a unit cost of $14,000 and 256 T39 (M57) HE heads at a unit cost of $4,770. To recover the potential losses in excess warhead sections, the ABMA undertook a study to determine the feasibility of converting them for use with the XM-50 rocket.

(U) The ABMA reported, in September 1961, that it would be technically feasible to convert the M6 warhead, but conversion of the other two conventional heads would not be worthwhile. The AOMC therefore recommended that funds be provided for conversion of the M6 head; that the T39 warhead be phased out with the M31 rocket; and that the T2043 warhead be returned to the CONUS for destruction because of its questionable storage life.[17]

(U) Tests conducted at the Yuma Test Station, in 1963, proved the adaptability of the M6 warhead section to the M66 rocket motor. The compatibility of the two was confirmed in flight tests conducted at the WSMR in 1964. The subsequent availability of an interchangeable M6 warhead reduced new procurement requirements for the M144 (T2044) warhead and resulted in substantial savings to the program.[18]

(U) As of June 1965, the standard M50 rocket consisted of one M66 rocket motor and any one of the following warhead sections: Atomic M27, M47, or M48; Practice M38; Chemical M190 (E19R2); HE M6; HE M144

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[17] (1) DF, Chf, ABMA Control Ofc, to DCG, AOMC, 7 Sep 61, sub: Fact Sheet - Excess M31 HJ Warhead Sections Due to Loss of Vehicles thru Over-Age Unserviceability. (2) Ltr, CG, AOMC, to CofOrd, 19 Sep 61, sub: Compatibility of the M6 & T2043 Warheads with the XM50 HJ Rkt. (3) Semiannual Hist Sum, ABMA, 1 Jul - 11 Dec 61, pp. 118, 122-26.

[18] (1) Annual Hist Sum, MICOM, 1 Jul 62 - 30 Jun 63, p. 123. (2) Annual Hist Sum, MICOM, 1 Jul 63 - 30 Jun 64, pp. 117-18.

(T2044); or HE XM-186.[19] The latest annual training objectives allow 12 rockets for each battalion in the Army and 1 rocket for each launcher issued to the Army National Guard. The basic battalion load is 16 rockets, 8 of them nuclear and 8 high explosive. The depot level of U. S. forces in the CONUS and overseas is 214 rockets for each battalion.[20] To maintain these authorized supply levels, procurement and production of the standard rocket was to continue as long as the system remained in the field.

U

(~~S~~) Honest John Deployment Status (U)

U (~~S~~) Aside from the 19 M33 Chopper Johns, 330 self-propelled Honest John launcher systems—96 M289's and 234 M386's—were still in active military service as of June 1965. Of these, 88 were assigned to tactical U. S. forces and 200 to NATO (MAP) commands, for a total of 72 battalions. The remaining 42 systems were assigned to the various schools and combat units as maintenance floats and training launchers (see Table 7).

U (~~S~~) Conversion of the Honest John system from active to reserve status began with the M33 units in 1964. When the new Lance missile system becomes operational in the late 1960's, all available Honest John equipment will be converted to reserve (National Guard) status.[21] Contingent upon the availability of the Lance system, the inactivation of U. S. Honest John battalions would begin in late 1967 and continue on a phased basis through mid-1972 (see Table 8). Meanwhile, the deployment status of the Honest John would remain essentially unchanged.

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[19] (1) Ibid., pp. 117-118. (2) AMCTCM's 364, 13 Dec 62; 955, 16 May 63; 2621, 17 Jun 64. RSIC. (3) For current status of the XM-186 warhead, see above, p. 125.

[20] DA Missile and Nuclear Programming Data (Short Title: MNPD), Nov 64, pp. 49-50. HJ Cmdty Ofc Files.

[21] MNPD, Nov 64, p. 51.

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Table 7—(~~S~~) DEPLOYMENT STATUS (U)
HONEST JOHN WEAPON SYSTEM
June 1965

Type/Location	LAUNCHER SYSTEM M289	M386	Total	Bn. Equiv
U. S. FORCES				
Tactical:				
Europe	0	44	44	11
Pacific	0	12	12	3
CONUS (STRAF)	0	32	32	8
Total Tactical	0	88	88	22
Non-Tactical:				
Maintenance Floats	0	6	6	
Training Launchers	2	8	10	
Total Non-Tactical	2	14	16	
TOTAL U. S. FORCES	2	102	104	
MAP (NATO) FORCES				
Tactical:				
Canada	0	6	6	1.5
United Kingdom	0	14	14	3.5
Denmark	4	4	8	2
Netherlands	12	0	12	3
Belgium	12	0	12	3
Germany	2	86	88	22
France	16	4	20	5
Italy	16	0	16	4
Greece	8	0	8	2
Turkey	16	0	16	4
Total Tactical:	86	114	200	50.0
Non-Tactical:				
Maintenance Floats	2	4	6	
Training Launchers	6	14	20	
Total Non-Tactical	8	18	26	
TOTAL MAP (NATO FORCES)	94	132	226	
RECAPITULATION:				
Tactical				
U. S. Forces	0	88	88	22
MAP Forces	86	114	200	50
Total Tactical	86	202	288	72
Non-Tactical				
Maintenance Floats	2	10	12	
Training Launchers	8	22	30	
Total Non-Tactical	10	32	42	
GRAND TOTAL	96	234	330	

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Table 8—Honest John Deactivation Date

NR	UNIT	LOCATION	*DEACTIVATION DATE	NR OF LCHRS
1	3rd Bn 32nd Arty	Fort Sill, Okla.	November 1967	4
2	2nd Arm Div (1/16 Arty)	Fort Hood, Tex.	January 1968	4
3	1st Arm Div (3/2 Arty)	Fort Hood, Tex.	April 1968	4
4	1st Inf Div (5/32 Arty)	Fort Riley, Kansas	July 1968	4
5	1st Bn 33rd Arty	Ansbach, Germany	October 1968	6
6	3rd Bn 21st Arty	Kitzingen, Germany	January 1969	6
7	3rd Arm Div (2/73 Arty)	Hanau, Germany	April 1969	4
8	4th Arm Div (2/16 Arty)	Zirndorf, Germany	July 1969	4
9	24th Inf Div (1/34 Arty)	Munich, Germany	October 1969	4
10	3rd Bn 79th Arty	Giessen, Germany	January 1970	6
11	1st Bn 32nd Arty	Hanau, Germany	April 1970	6
12	3rd Inf Div (1/9 Arty)	Kitzingen, Germany	July 1970	4
13	8th Inf Div (1/28 Arty)	Wackernheim, Germany	October 1970	4
14	1st Bn 42nd Arty	Page CP, Korea	January 1971	4
15	2nd Inf Div (1/12 Arty)	Fort Benning, Ga.	April 1971	4
16	1st Cav Div (2/20 Arty)	Pobwon-Ni, Korea	July 1971	4
17	5th Inf Div (6/21 Arty)	Fort Carson, Colo.	October 1971	4
18	7th Inf Div (1/31 Arty)	Casey CP, Korea	January 1972	4
19	4th Inf Div (1/20 Arty)	Fort Lewis, Wash.	April 1972	4
20	2nd Bn 30th Arty	Fort Sill, Okla.	July 1972	4

*Deactivation dates contingent upon Lance availability dates.

SOURCE: DA Message 973833, 17 Jun 64.

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APPENDIX A

FLIGHT TEST PROGRAM
IMPROVED HONEST JOHN WEAPON SYSTEM

May 1955 - December 1962

Compiled by:

Miss Frances Strowd
Editorial Assistant

LIST OF TABLES

PROGRAM SUMMARY
May 1955 — December 1962

Test Phase	Period Fired	Total Rounds	
Rocket Development			
Research Tests...........................	May 55—Feb 56	27	
Spin-Buck Demonstration (XM-50 Mockups)..	May 57—Sep 57	11	38
Launcher Development			
XM-386 Feasibility Test w/M31 Rocket.....	Oct 56—Jun 57	33	
XM-33 Feasibility Test w/M31 Rocket......	Jul 56—Oct 56	20	
XM-33 Qualification Test w/M31 Rocket....	Jul 57—Oct 57	23	
XM-386 Engineer Test w/M31 Rocket........	Dec 57—Feb 58	24	
XM-33 Engineer Test w/M31 Rocket.........	Mar 58—May 58	20	120
TOTAL XM-50 MOCKUP/M31 FIRINGS..........................			158
Integrated Test Program: XM-50 Rocket			
R&D: Spin-Buck Test Rounds..............	Jun 58—Mar 59	33	
Straight-Spin Test Rounds..........	Mar 59—Dec 62	234	
Special Slim John Test Rounds......	Nov 58—Jun 61	9	276[a]
User Tests...............................	Jul 59—Feb 62		38[b]
Engineer Tests...........................	Mar 60—Oct 62		101
Quality Assurance Tests..................	May 61—Nov 62		47
Production Tests.........................	Sep 61—Feb 62		12
TOTAL XM-50 FIRINGS...................................			474
TOTAL M31/XM-50 FIRINGS..................	May 55—Dec 62		632

NOTES:

[a] Excludes special warhead firings at Yuma Test Station, Arizona.

[b] Includes 12-round service test at Fort Bliss, Texas, July 1959.

TABLE I—Rocket Research Test Program
OBJECTIVE: To determine magnitude of thrust malalignment and actual yaw oscillation distance of M31 series rocket.

Round Number	Date Fired	Remarks
382/383-RO 385/386-RO 390/391-RO 397/398-RO	May 55 3 Jun 55 21 Jun 55 13 Jul 55	First eight rounds fired in Honest John Improvement Program. All rounds equipped with standard fins for variable stability test. All test objectives achieved.
402/403-RO	3 Aug 55	Variable stability test of rounds with 16-inch clipped fins.
404-RO	4 Aug 55	Yaw oscillation test using 16-inch clipped fins.
405/406-RO 407/408-RO 420/421-RO	8 Aug 55 8 Aug 55 1 Sep 55	Variable stability tests using 16-inch clipped fins. All considered satisfactory.
440-RO	30 Sep 55	Yaw oscillation round with clipped fins. Instrumentation partially lost—test later repeated (see Round 483-RO below).
468/469-RO 478/479-RO	16 Dec 55 20 Jan 56	Variable stability tests using clipped fins. Satisfactory.
483-RO	27 Jan 56	Final yaw oscillation test. Results satisfactory.
486/487-RO 490/491-RO	13 Feb 56 13 Feb 56	Last four firings in Phase I of R&D program. Variable stability tests using 16-inch clipped fins. Results satisfactory.

TABLE II—Spin-Buck Feasibility Demonstration
(XM-50 Mockups—Modified M31 Rockets)

Round Number	Date Fired	Remarks
645-RO 661/662-RO 665/666-RO 670/671-RO 679/680-RO 683/684-RO	25 May 57 16 Jul 57 6 Aug 57 15 Aug 57 11 Sep 57 17 Sep 57	Objective: To determine feasibility of the spin-buck system and clipped fin design as a means of improving system accuracy. All rounds were temperature conditioned at 77°F. and fired from the standard M289 launcher at a quadrant elevation of 400 mils. Test results indicated that the new spin-fin design would provide the desired improvement in deflection accuracy.

NOTE: Round Number suffix (RO) denotes the test phase and type warhead: R&D/Concrete Ballast.

SOURCE: Teletype Reports, WSPG to CofOrd (ORDTU Files, 1955-57, FRC).

TABLE III—XM-386 Launcher: Feasibility Test of R&D Prototype with M31 Series Rocket

Round Number	Date Fired	Remarks
571-RL 574-RL 583/584-RL	18 Oct 56 23 Oct 56 15 Nov 56	All four firings considered satisfactory, except for interference between rocket and launcher rail in Rounds 583 & 584-RL.
597-RL	18 Jan 57	Rear launching shoe struck rail as rocket left the launcher.
600-RL	30 Jan 57	Interference between rocket and launcher rail.
610-RL	3 Apr 57	Higher rear shoes installed. Rocket did not hit rail.
619-RL	19 Apr 57	Left rear shoe hit striker bar, shearing shoe bolts. Shoe found 300 feet downrange. Rocket did not hit rail under these conditions.
626/627-RL 628/629-RL	2 May 57 2 May 57	Left half of bottom rear shoe hit striker bar on #2 launcher, shearing bolts and throwing shoe about 150 feet downrange.
630/631-RL	3 May 57	Both firings satisfactory.
632-RL	6 May 57	Satisfactory. This round meant to be fired as one of a pair, but personnel erroneously in impact area prevented second firing.
635/636-RL 637/638-RL 639/640-RL	10 May 57 14 May 57 14 May 57	All six firings considered satisfactory.
641/642-RL	16 May 57	Both firings satisfactory.
649-RL 650-RL	6 Jun 57 6 Jun 57	Instrumented launchers, one with and one without optical lever. Both satisfactory.
651/652-RL	7 Jun 57	Instrumented launchers without optical lever.
653/654-RL 655/656-RL 657/658-RL	17 Jun 57 17 Jun 57 21 Jun 57	Normal coverage. Feasibility of launcher successfully established.

NOTES: Round Number suffix (RL) denotes the test phase and type launcher: R&D/XM-386.
All M31 rounds carried concrete ballast heads.

SOURCE: (1) HJ Activity Reports, WSPG: Oct 56, Jan 57, Apr 57, Jun 57, & Jul 57. (2) TT's, CG, WSPG, to CofOrd: 22 Jan 57, 1 Feb 57, 8 May 57, 13 May 57, 16 May 57, & 17 May 57. (3) Monthly Progress Rept, Proj TU2-1029, 21 Apr - 20 May 57. ORDTU Files, Sep - Dec 56 & Jan - May 57, FRC; and HJ R&D Case Files, Box 13-542, RHA.

TABLE IV—(C) XM-33 HTL: Feasibility Tests of R&D Prototype with M31 Rockets

Round Numbers	Dates Fired	QE (Degrees)	Actual Impact	
			Range (Yds)	Deflection (Yds)
537-RH	24 Jul 56	35	25,419	1,190.0 Right
538-RH	6 Aug 56	50	29,394	935.7 Right
539-RH	10 Aug 56	10	8,596	47.7 Left
542-RH	20 Aug 56	35	26,176	332.6 Right
543-RH	22 Aug 56	10	6,659	48.3 Left
544-RH	24 Aug 56	35	25,024	1,385.0 Right
548-RH	12 Sep 56	10	7,356	224.3 Right
556-RH	17 Sep 56	10	6,179	152.3 Right
557-RH	24 Sep 56	11	8,875	245.0 Left
558-RH	24 Sep 56	11	7,048	58.8 Left
559-RH	24 Sep 56	11	8,031	54.2 Right
560-RH	24 Sep 56	11	7,480	1.6 Left
561-RH	25 Sep 56	35	25,549	226.3 Left
562-RH	25 Sep 56	35	25,386	378.0 Right
563-RH	25 Sep 56	35	25,468	71.0 Right
564-RH	25 Sep 56	35	24,964	82.0 Right
565-RH	28 Sep 56	50	28,531	181.7 Right
566-RH	28 Sep 56	50	28,733	586.7 Right
567-RH	16 Oct 56	50	28,647	878.0 Right
568-RH	16 Oct 56	50	28,927	1,606.0 Right

SOURCE: TT, CG, RSA, to CofOrd, 23 Oct 56. ORDTU Files, Sep-Dec 56, FRC.

NOTE: Round Number suffix (RH) denotes the test phase and type launcher used: R&D/XM-33. All rounds carried concrete ballast warheads.

TABLE V
XM-33 HTL—R&D Tests of Tactical Prototype With M31 Series Rocket*

OBJECTIVES ACHIEVED: XM-33 qualified for tactical use with M31 rocket.

Round Number	Date Fired
663-RH	30 Jul 57
664-RH	30 Jul 57
669-RH	7 Aug 57
674-RH	23 Aug 57
677-RH	9 Sep 57
678-RH	9 Sep 57
687-RH	18 Sep 57
688-RH	18 Sep 57
689-RH	27 Sep 57
690-RH	27 Sep 57
693-RH	1 Oct 57
694-RH	1 Oct 57
697-RH	4 Oct 57
698-RH	4 Oct 57
701-RH	23 Oct 57
702-RH	23 Oct 57
705-RH	24 Oct 57
706-RH	24 Oct 57
707-RH	25 Oct 57
708-RH	28 Oct 57
709-RH	28 Oct 57
710-RH	29 Oct 57
711-RH	29 Oct 57

TABLE VI
XM-386 Launcher—Engineer Qualification Tests With M31 Series Rocket*

OBJECTIVES ACHIEVED: Data obtained for correction of firing tables.

Round Number	Date Fired
722-EL	6 Dec 57
723-EL	6 Dec 57
724-EL	6 Dec 57
725-EL	6 Dec 57
726-EL	9 Dec 57
727-EL	9 Dec 57
728-EL	9 Dec 57
729-EL	9 Dec 57
730-EL	12 Dec 57
731-EL	12 Dec 57
732-EL	16 Dec 57
733-EL	16 Dec 57
734-EL	17 Dec 57
735-EL	17 Dec 57
736-EL	19 Dec 57
737-EL	19 Dec 57
738-EL	19 Dec 57
739-EL	19 Dec 57
754-EL	7 Feb 58
755-EL	7 Feb 58
756-EL	13 Feb 58
757-EL	13 Feb 58
758-EL	14 Feb 58
759-EL	14 Feb 58

TABLE VII
XM-33 HTL—Engineer Qualification Tests With M31 Series Rocket*

OBJECTIVES ACHIEVED: Data obtained for correction of firing tables.

Round Number	Date Fired
766-EH	13 Mar 58
767-EH	13 Mar 58
774-EH	21 Apr 58
775-EH	21 Apr 58
776-EH	21 Apr 58
777-EH	21 Apr 58
780-EH	25 Apr 58
781-EH	25 Apr 58
782-EH	25 Apr 58
783-EH	25 Apr 58
784-EH	25 Apr 58
785-EH	25 Apr 58
788-EH	2 May 58
789-EH	2 May 58
792-EH	6 May 58
793-EH	6 May 58
794-EH	7 May 58
795-EH	7 May 58
798-EH	16 May 58
799-EH	16 May 58

*SOURCE: Teletype Reports, WSMR to CofOrd (ORDTU Files, 1957-58, FRC).

NOTE: Round Number suffix denotes the Test Phase and Type Launcher:
RH - R&D/XM-33
EL - Engineer/XM-386
EH - Engineer/XM-33
All rounds carried concrete ballast warheads.

TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET
June 1958 — December 1962

Explanatory Notes

ROUND NUMBER PREFIX

Rounds without a prefix represent the initial XM-50 model equipped with the spin-buck system which was dropped in March 1959.

Rounds preceded by "E" are XM-50's equipped with the straight (monotonic) spin system.

Rounds with the "SJ" prefix are Slim Johns used in special over-acceleration tests.

ROUND NUMBER SUFFIX

All round numbers have a 3-letter suffix denoting the test phase, the type warhead, and the type launcher, in that order. The code letters used in each category are defined below.

Test Phase	Type Warhead	Type Launcher
R - Research & Development	O - Light Concrete Ballast	L - M386
E - Engineer	D - Heavy Concrete Ballast	H - XM-33
A - Quality Assurance	G - Chemical (E19R2)	X - M289
P - Production	M - High Explosive (T2044)	
U - User	P - Practice (XM-38 series)	
	S - Special (XM-27, XM-48)	
	B - T39 Type	
	A - Over-Acceleration	

For example, the suffix RDL denotes an R&D test round equipped with the Heavy Concrete Ballast Warhead and fired from the M386 launcher.

OTHER ABBREVIATIONS:

Chg.....	Charge	L......	Left
Deflect.	Deflection	N/A....	Not Applicable
E.......	East	QE.....	Quadrant Elevation
F.......	Fahrenheit	R......	Right
GT......	Grain Temperature	TM.....	Telemetry
IHJ.....	Improved Honest John	W......	West

--------- Data Not Available

TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET
June 1958 — December 1962

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact* Range	Actual Impact* Deflect	Objectives	Remarks
1-ROL	17 Jun 58	72	889	49,564	67 E	Obtain aerodynamic and structural information on XM-50 round.	Both pedestal doors blown off at launch. Premature ignition of spin buck jatos.
2-ROL	9 Jul 58	105	106	10,659	65 E	" " " "	Spin buck rockets did not function.
3-ROL	24 Jul 58	80	400	31,279	424 E	Performance and accuracy data on XM-50.	Successful performance.
4-RML	6 Aug 58	87	400	30,181	557 E	Check functioning of T2044 (modified M6) warhead on XM-50.	Successful performance.
5-ROL	12 Aug 58	120	400	29,571	490 W	Performance and accuracy data on XM-50.	Premature ignition of spin buck jatos.
6-ROL	25 Aug 58	-30	400	29,577	221 W	" " " " " "	Successful performance.
7-ROL	25 Aug 58	-30	400	28,832	644 W	" " " " " "	Successful. Early second bank.
8-ROL	23 Sep 58	20	400	30,293	763 W	" " " " " "	Spin buck rockets did not ignite.
9-ROL	30 Sep 58	78	400	29,739	1,104 E	" " " " " "	Successful.
10-ROL	30 Sep 58	79	400	31,360	1,195 E	" " " " " "	Second bank failed to fire.
11-ROL	3 Oct 58	19	400	29,378	754 E	" " " " " "	Successful.
12-ROL	3 Oct 58	20	400	29,405	434 E	" " " " " "	Successful.
13-ROL	10 Oct 58	79	800	25,169	2,053 E	Obtain performance and accuracy data and stability characteristics on XM-50.	Successful.
14-RMH	10 Oct 58	78	400	30,519	625 E	Check functioning of T2044 (modified M6) warhead on XM-50.	Successful.
SJ- 1-ROL	3 Nov 58	117	889	74,513	1,878 W	Over-acceleration data on modified XM-50 rocket.	Successful.
SJ- 2-ROL	7 Nov 58	111	400	N/A	N/A	" " " " "	Successful.
15-ROL	18 Nov 58	125	400	30,208	11 W	Obtain performance and accuracy data on XM-50 rocket.	Successful.
16-ROL	18 Nov 58	125	400	28,463	104 E		Successful. Late second bank.
17-ROL	25 Nov 58	118	400	31,790	527 W	Obtain performance and accuracy data on XM-50 rocket.	Successful.
18-ROL	25 Nov 58	119	400	30,025	959 W		Successful.
19-RGX	25 Nov 58	76	400	28,203	1,298 W	Check stability and adequacy of chemical warhead with XM-50 rocket.	Successful.
SJ- 3-ROL	4 Dec 58	130	889	85,257	6,185 E	Obtain over-acceleration data on the modified XM-50 rocket motor.	Successful.
20-ROL	16 Dec 58	76	800	40,869	1,004 E	Obtain performance and accuracy data on the XM-50 rocket.	Telemetry data lost.
21-ROL	22 Jan 59	74	400	30,143	929 E	Special (TM) (Spot Chg) (Picatinny Fuze).	First test of reworked roll inertia switch.
22-ROL	22 Jan 59	74	400	29,526	358 E		
23-RML	3 Feb 59	76	200	13,279	3,529 E	Airburst.	Successful.
24-ROL	10 Feb 59	117	400	23,943	434 E	Obtain performance and accuracy data on the XM-50 rocket.	Unexplained short range.
25-ROL	10 Feb 59	113	400	29,931	183 E		
26-ROL	20 Feb 59	71	200	18,607	563 E	6 & 5 roll inertia switches monitored.	Simultaneous ignition, both banks.
27-ROL	20 Feb 59	71	200	16,465	482 W		
28-RGX	12 Mar 59	75	400	29,093	310 W	Airburst.	Successful.
29-ROL	16 Mar 59	77	800	N/A	N/A	Nudger test vehicle.	Erratic motion.
30-ROL	24 Mar 59	74	400	30,961	577 W	5 roll inertia switches.	Switches operated properly.
E- 1-ROL	25 Mar 59	71	400	30,746	2,191 W	Monotonic Spin.	1-second pair.
E- 2-ROL	25 Mar 59	69	400	29,193	2,097 W	Monotonic Spin.	

*In yards, except Rounds 24/25-ROL whose range is in Meters.

TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET - Continued
June 1958 — December 1962

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact** Range	Actual Impact** Deflect	Objectives	Remarks
31-ROL	26 Mar 59	72	400	29,408	1,013 E	5 roll inertia switches.	Switches operated properly.
32-ROL	26 Mar 59	74	400	31,773	92 E	Last XM-50 test w/spin buck rocket.	
E- 3-ROL	9 Apr 59	76	400	30,231	677 W	Monotonic spin.	Deflection acceptable.
E- 4-ROL	9 Apr 59	76	400	30,771	936 W	Monotonic spin.	Range acceptable.
E- 5-ROL	10 Apr 59	74	400	30,010	203 E	Monotonic spin.	Range acceptable.
E- 6-ROL	10 Apr 59	76	400	30,250	213 E	Monotonic spin.	Range acceptable.
E- 7-ROL	14 Apr 59	66	400	30,387	659 E	Monotonic spin.	Range acceptable.
E- 8-ROL	14 Apr 59	70	400	29,882	471 E	Monotonic spin.	Range acceptable.
33-ROL	15 Apr 59	117	200	12,997	162 E	Special instrumented round w/no spin system and no fin cant, to determine cause of range error.	Afterburn measured. Pitch and yaw analyzed.
E- 9-ROL	17 Apr 59	77	400	31,327	257 W	Monotonic spin.	Low drag after burnout.
E- 10-ROL	17 Apr 59	76	400	32,655	523 W	Monotonic spin. (Picatinny Fuze).	Low drag after burnout.
E- 11-ROL	5 May 59	23	400	29,389	504 W	Monotonic spin. Nozzle collar.	Deflection acceptable.
E- 12-ROL	5 May 59	25	400	27,776	658 W	Monotonic spin. Nozzle collar.	Afterburning effect produced unacceptable range error.
E- 13-ROL*	2 Jun 59	78	400	29,323	863 E	Monotonic spin. Nozzle collar.	Good range performance.
E- 14-ROL*	2 Jun 59	78	400	29,779	441 E	Monotonic spin. Nozzle collar.	Good range performance.
E- 15-RML	2 Jun 59	78	200	12,692	157 E	Airburst. Thermolag on nozzle.	
E- 16-ROL*	5 Jun 59	79	400	29,910	429 W	Monotonic spin. Nozzle collar.	Satisfactory.
E- 17-ROL*	5 Jun 59	79	400	29,324	863 W	Monotonic spin. Nozzle collar.	Satisfactory.
E- 18-ROL*	19 Jun 59	78	200	16,581	658 E	Monotonic spin. Thermolag on nozzle.	Satisfactory.
E- 19-ROL*	19 Jun 59	78	200	17,752	491 E	Monotonic spin. Thermolag on nozzle.	Satisfactory.
E- 20-ROL*	20 Jun 59	79	200	18,098	100 W	Monotonic spin. Thermolag on nozzle.	Satisfactory.
E- 21-ROL*	20 Jun 59	78	200	17,336	251 W	Monotonic spin. Thermolag on nozzle.	Satisfactory.
E- 22-ROL*	20 Jun 59	79	200	16,717	318 W	Monotonic spin. Thermolag on nozzle.	Satisfactory.
E- 23-ROL*	20 Jun 59	78	200	17,275	543 W	Monotonic spin. Thermolag on nozzle.	Satistactory.
E- 24-ROL*	20 Jun 59	79	200	16,955	476 W	Monotonic spin. Thermolag on nozzle.	Satisfactory.
E- 25-ROL*	20 Jun 59	80	200	17,714	554 W	Monotonic spin. Thermolag on nozzle.	Satisfactory.
E- 26-ROL*	22 Jun 59	78	200	14,701	130 W	Monotonic spin. Thermolag on nozzle.	Spin rocket malfunctioned.
E- 27-ROL*	22 Jun 59	80	200	17,132	431 W	Monotonic spin. Thermolag on nozzle	Satisfactory.
E- 28-ROL*	26 Jun 59	76	800	44,306	2,101 W	Monotonic spin. Thermolag on nozzle	Satisfactory.
E- 29-ROL*	26 Jun 59	76	800	44,441	2,568 W	Monotonic spin. Thermolag on nozzle.	Satisfactory.
E- 30-ROL*	29 Jun 59	75	800	44,277	710 E	Monotonic spin. Thermolag on nozzle.	Satisfactory.
E- 31-ROL*	29 Jun 59	74	800	44,731	131 W	Monotonic spin. Thermolag on nozzle.	Satisfactory.
E- 32-ROL*	1 Jul 59	76	800	43,630	505 W	Monotonic spin. Thermolag on nozzle.	Pedestal door failed.
E- 33-ROL*	1 Jul 59	75	800	43,016	1,054 W	Monotonic spin. Thermolag on nozzle.	Satisfactory performance.
E- 34-ROL*	2 Jul 59	79	800	43,894	1,384 E	Monotonic spin. Thermolag on nozzle.	Satisfactory performance.
E- 35-ROL*	2 Jul 59	78	800	44,072	224 W	Monotonic spin. Thermolag on nozzle.	Satisfactory performance.
E- 36-ROL*	2 Jul 59	80	800	44,059	193 E	Monotonic spin. Thermolag on nozzle.	Satisfactory performance.
E- 37-ROL*	2 Jul 59	81	800	43,433	168 W	Monotonic spin. Thermolag on nozzle	Satisfactory performance.

*XM31E2 motor w/inert sliver.
**In yards.

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TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET - Continued
June 1958 — December 1962

Phase I - XM-50 Rocket User Test Program (U)
Conducted at Fort Bliss, Texas - 15-16 July 1959
(Rounds fired in pairs from M386 Launchers #3 & 11)

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact Range	Actual Impact Deflect
				Meters	Mils
91		86	400	26,611	16 R
93		90	400	26,903	10 R
92		85	400	27,025	15 L
96		86	400	27,808	24 L
94		89	400	26,793	40 L
95		90	400	27,817	43 L
99		86	800	39,569	31 R
100		82	800	39,371	26 R
98		83	800	39,473	22 L
102		80	800	39,178	16 L
97		83	800	39,549	44 R
101		85	800	39,709	14 R

SOURCE: (1) TT, President, U.S. Army Artillery Board, Ft Bliss, Tex., to CG, CONARC, 6 Aug 59. HJ R&D Case Files, Box 13-563, RHA. (2) Ltr, DAC, to CG, AOMC, 3 Aug 59, sub: Contr DA-04-495-ORD-693 - HJ XM-50 Rkt User Test Program, w/4 incls. HJ R&D Case Files, Box 13-562, RHA.

CONCLUSIONS:

a. Sample of 6 pairs of XM-50 rockets for Phase I of Service Test was too small to be conclusive.

b. No significant improvement in deflection PE was noted for XM-50 over M31 rocket.

c. Range PE for ground impact of about 300 meters is essentially the same as that for M31 rocket.

d. Firing results of this board alone do not warrant an unqualified statement of acceptance of the XM-50 rocket.

e. Substantial range increase of XM-50 will provide markedly improved lateral mutual support as well as depth to division rocket atomic delivery capability.

f. Handling advantage of lighter weight, improved resistance to environment, and increased rate of fire favor XM-50 over M31.

RECOMMENDATIONS: That CG, USCONARC, concur with recommendation of CG, AOMC, to release XM-50 rocket for Limited Production.

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact* Range	Actual Impact* Deflect	Objectives	Remarks
E- 38-RMH	22 Jul 59	78	300	22,393	524 E	Development range table addendum. Split load launcher.	Satisfactory.
E- 39-RGH	28 Jul 59	80	300	31,176	635 W	Development range table addendum. Split load launcher.	Satisfactory.
E- 40-RMH	29 Jul 59	78	300	23,028	446 E	Development range table addendum. Split load launcher.	Satisfactory.
E- 41-ROL	18 Aug 59	78	200	16,479	240 W	Bias study - 200 mil matrix	Left impact recorded for all four rounds; however, deflection spread limited to 12 mil. Range table data acceptable.
E- 42-ROL	18 Aug 59	79	200	16,478	480 W	" " " " "	
E- 43-ROL	21 Aug 59	80	200	16,948	79 W	" " " " "	
E- 44-ROL	21 Aug 59	80	200	16,114	73 E	" " " " "	
E- 45-ROL	1 Sep 59	77	200	12,479	114 W	Bias study - 200 mil matrix	Unsatisfactory—Spin rocket malfunctioned.
E- 46-ROL	1 Sep 59	79	200	14,521	119 E	" " " " "	
E- 47-RML	8 Sep 59	77	800	39,814	358 E	Firing table addendum.	Unsatisfactory. Premature impact.
E- 48-ROL	10 Sep 59	79	200	15,032	566 E	Bias study - 200 mil matrix.	Unsatisfactory. Spin rocket malfunctioned.
E- 49-ROL	21 Sep 59	79	200	17,017	420 W	Bias study - 200 mil matrix.	Satisfactory. No apparent bias.
E- 50-ROL	21 Sep 59	79	200	17,082	251 W	Bias study - 200 mil matrix.	Satisfactory. No apparent bias.
E- 51-ROL	22 Sep 59	77	200	13,381	414 E	Cantilevered fin evaluation. No roll round.	Satisfactory performance.

*In yards.

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TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET - Continued
June 1958 — December 1962

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact* Range	Deflect	Objectives	Remarks
E- 52-ROL	28 Sep 59	76	800	44,812	477 E	Bias study - 800 mil matrix.	Satisfactory performance.
E- 53-ROL	5 Oct 59	75	800.3	42,553	1,150 E	Bias study - 800 mil matrix.	Satisfactory performance.
E- 54-RML	6 Oct 59	74	800	38,704	2,011 W	Firing table addendum.	Satisfactory performance.
E- 55-RGX	6 Oct 59	74	600	38,501	675 E	Firing table addendum.	Satisfactory performance.
E- 56-RML	12 Oct 59	77	800	39,811	688 E	Firing table addendum.	Satisfactory performance.
E- 57-ROL	12 Oct 59	79	400	29,641	295 W	M386 launcher firing table.	Satisfactory performance.
E- 58-ROL	12 Oct 59	78	400	29,869	625 W	M386 launcher firing table.	Satisfactory performance.
E- 59-RPL	16 Oct 59	77	800	43,982	1,633 E	M386 launcher firing tables and	Satisfactory performance.
E- 60-RPL	16 Oct 59	73	800	43,961	724 E	XM-38 practice head.	Satisfactory performance.
E- 61-RML	19 Oct 59	77	800	39,338	403 E	Firing table addendum.	Satisfactory performance.
E- 62-ROL	20 Oct 59	77	400	29,408	387 W	M386 launcher firing tables.	Satisfactory performance.
E- 63-ROL	20 Oct 59	73	400	28,847	655 E	M386 launcher firing tables.	Satisfactory performance.
E- 64-ROL	23 Oct 59	117	400	28,835	219 E	M386 launcher firing tables.	Satisfactory performance.
E- 65-ROL	23 Oct 59	116	400	28,704	127 E	M386 launcher firing tables.	Satisfactory performance.
E- 66-RML	26 Oct 59	77	153	9,850	2,120 E	Firing table addendum (upleg).	Satisfactory performance.
E- 67-ROL	6 Nov 59	21	400	28,487	22 E	Range table data.	Satisfactory performance.
E- 68-ROL	6 Nov 59	17	400	28,363	160 W	Range table data.	Satisfactory performance.
E- 69-ROL	10 Nov 59	119	400	28,314	532 W	Range table data.	Satisfactory performance.
E- 70-ROL	10 Nov 59	118	400	28,002	368 W	Range table data.	Satisfactory performance.
E- 71-ROL	16 Nov 59	77	107	5,806	8 W	Elevation of new ignition system,	Satisfactory.
E- 72-ROL	16 Nov 59	77	107	5,660	42 E	magnesium fin and range table data.	Satisfactory.
E- 73-ROL	20 Nov 59	73	107	5,459	15 E	Elevation of new ignition system,	Satisfactory.
E- 74-ROL	20 Nov 59	75	107	5,282	88 W	magnesium fin and range table data.	Satisfactory.
E- 75-RPL	25 Nov 59	-30	400	27,570	543 E	XM-38 warhead elevation.	Satisfactory.
E- 76-RPL	25 Nov 59	-30	400	26,523	1,932 E	Range table data.	Premature spin.
E- 77-ROL	4 Jan 60	109	400	29,880	47 W	Range table data. Test of	Satisfactory.
E- 78-ROL	4 Jan 60	107	400			suppressor.	Satisfactory.
E- 79-RGL	15 Jan 60	71	400	26,875	604 E	Capability of E19R2 warhead; Firing table data M386 launcher.	Early ignition of spin rockets.
E- 80-ROL	5 Feb 60	120	400	28,638	1,309 W	Range table data and spin rocket ignition circuit evaluation.	Satisfactory.
E- 81-RML	5 Feb 60	77	149	8,845	16.3 W	Warhead functioning and range table data.	Satisfactory.
E- 82-ROL	5 Feb 60	120	400	28,990	948 W	Range table data and spin rocket ignition circuit evaluation.	Satisfactory.
E- 83-ROL	11 Feb 60	77	200	16,734	140 W	Range table data and spin rocket	Satisfactory.
E- 84-ROL	11 Feb 60	77	200	16,563	79 E	ignition circuit evaluation.	Satisfactory.
E- 85-ROL	11 Feb 60	-30	400	27,187	191 E	Range table data and spin rocket	Satisfactory.
E- 86-ROL	11 Feb 60	-30	400	27,468	39 E	ignition circuit evaluation.	Satisfactory.
E- 87-RML	12 Feb 60	44	140	4,629	372 W	Warhead functioning and range table	Satisfactory.
E- 88-RML	12 Feb 60	40	142	6,047	138 W	data.	Satisfactory.
E- 89-RPL	15 Feb 60	-28	400	27,001	979 W	Range table data and spin rocket	Satisfactory.
E- 90-RPL	15 Feb 60	-28	400	27,677	529 W	ignition circuit evaluation.	Satisfactory.
E- 91-RML	17 Feb 60	77	163	10,233	41.5 E	Warhead functioning and range table data.	Satisfactory.

*In yards.

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TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET - Continued
June 1958 — December 1962

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact* Range	Deflect	Objectives	Remarks
SJ- 4-ROX	17 Feb 60	119	708.4	66,370	536 W	Over acceleration test of XM66 rocket motor assembly.	Satisfactory.
E- 92-RDL	18 Feb 60	72	200	14,959	124 W	Range table data and spin rocket	Satisfactory.
E- 93-RDL	18 Feb 60	73	200	14,615	13 E	ignition circuit evaluation.	Satisfactory.
E- 94-RDL	23 Feb 60	74	200	14,605	72 E	Range table data and spin rocket	Satisfactory.
E- 95-RDL	23 Feb 60	72	200	14,092	146 E	ignition circuit evaluation.	Satisfactory.
E- 96-RML	23 Feb 60	74	385	26,602	866 E	Warhead functioning and range table data.	Satisfactory.
E- 97-ROL	25 Feb 60	20	400	27,811	642 E	Range table data and spin rocket ignition circuit evaluation.	Satisfactory.
E- 98-ROL	25 Feb 60	19	400	27,834	364 E	Over acceleration test of XM66 rocket motor assembly.	Satisfactory.
E- 99-RDL	3 Mar 60	77	200	14,619	197 W	Obtain data for firing table design	Satisfactory.
E-100-RDL	3 Mar 60	75	200	14,373	100 W	at 77°F. grain temperature.	Satisfactory.
E-101-RDL	3 Mar 60	79	800	39,868	1,273 E	Obtain data for firing table design	Satisfactory.
E-102-RDL	3 Mar 60	80	800	39,745	1,578 E	at 77°F. grain temperature.	Satisfactory.
E-103-RDL	3 Mar 60	77	800	39,264	1,210 E	Obtain data for firing table design	Satisfactory.
E-104-RDL	3 Mar 60	78	800	39,586	1,592 E	at 77°F. grain temperature.	Satisfactory.
E-105-RML	10 Mar 60	77	600	34,173	952 E	Compatibility & functioning of the	Satisfactory.
E-106-RML	10 Mar 60	76	600	34,152	922 E	T2044 warhead-XM-50 rocket.	Satisfactory.
E-107-RDL	11 Mar 60	77	400	26,664	202 E	Firing table design at 77°F. grain	Normal flight.
E-108-RDL	11 Mar 60	78	400	26,875	83 W	temperature.	Normal flight.
E-109-RML	16 Mar 60	76	200	15,409	220 W	Compatibility & functioning of the T2044 warhead-XM-50 rocket.	Normal flight.
E-110-RML	16 Mar 60	76	800	38,999	943 W	Compatibility & functioning of the T2044 warhead-XM-50 rocket.	Normal flight.
E-111-EOL	18 Mar 60	81	800	46,032	412	Accuracy and reliability of the XM-50	Satisfactory performance.
E-112-EOL	18 Mar 60	81	800	46,209	1,209	system.	
E-113-EOL	22 Mar 60	81	400	29,862	180 W	Accuracy & reliability of the system	Satisfactory performance.
E-114-EOL	22 Mar 60	81	400	29,826	179 E	& extreme temperature environments.	Satisfactory performance.
E-115-EPL	22 Mar 60	81	400	27,415	106 E	Compatibility & suitability of XM-38	Satisfactory performance.
E-116-EPL	22 Mar 60	81	400	27,558	139 E	warhead for use w/XM-50 system.	Satisfactory performance.
E-117-EBL	25 Mar 60	80	400	26,789	277 E	Compatibility & suitability of T-39 warhead for use w/XM-50 system.	Satisfactory performance.
E-118-EOL	30 Mar 60	18	400	30,324	91 E	Extreme temperature environments &	Satisfactory performance.
E-119-EOL	30 Mar 60	20	400	30,397	687 W	optimum handling & firing procedures.	Satisfactory performance.
E-120-EDL	30 Mar 60	80	400	27,232	1,007 W	Extreme temperature environments & optimum handling & firing procedures.	Satisfactory performance.
E-121-EOL	1 Apr 60	115	400	30,027	1,625 W	Engineering test for accuracy and	Satisfactory.
E-122-EOL	1 Apr 60	118	400	29,801	356 W	reliability.	Satisfactory.
E-123-UML	4 Apr 60	60	254	------	-------	User warhead function and accuracy.	Satisfactory.
E-124-EOL	7 Apr 60	16	400	29,549	615 W	Engineer accuracy and reliability.	Satisfactory.
E-125-EOL	7 Apr 60	17	400	29,464	571 W	" " " "	Satisfactory.
E-126-EDL	7 Apr 60	119	400	27,224	677 W	Engineer accuracy and reliability.	Satisfactory.
E-127-EDL	7 Apr 60	120	400	27,261	774 W	" " " "	Satisfactory.
E-128-UML	18 Apr 60	62	213	N/A	N/A	User warhead function and accuracy.	Satisfactory.

*In yards.

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TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET - Continued
June 1958 — December 1962

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact* Range	Actual Impact* Deflect	Objectives	Remarks
E-129-RML	20 Apr 60	76	356	22,709	872 W	User warhead function and accuracy.	Satisfactory.
E-130-UML	25 Apr 60	62	395	------	-------	User warhead function and accuracy.	Satisfactory.
E-131-RML	26 Apr 60	75	800	42,210	1,015 W	User warhead function and accuracy.	Satisfactory.
E-132-ROH	26 Apr 60	75	400	30,933	290 W	Development range tables.	Satisfactory.
E-133-ROH	26 Apr 60	76	400	30,666	90 W	Development launcher range tables.	Satisfactory.
E-134-EOL	28 Apr 60	-30	400	29,900	416 W	Engineer accuracy and reliability.	Satisfactory.
E-135-EOL	28 Apr 60	-28	400	59,526	6.8 W	" " " "	"
E-136-UML	2 May 60	60	398	------	-------	User warhead function & reliability.	Satisfactory.
E-137-ROH	3 May 60	77	400	30,882	983 W	Development launcher range tables.	Satisfactory.
E-138-ROH	3 May 60	77	400	30,724	820 W	" " " "	"
E-139-EDL	9 May 60	-32	400	25,955	495 E	Engineer accuracy & reliability.	Satisfactory.
E-140-EDL	9 May 60	-32	400	25,781	39 W	" " " "	"
E-141-ROH	11 May 60	118	400	30,899	72 E	Development launcher range tables.	Satisfactory.
E-142-ROH	11 May 60	120	400	31,178	1,005 E	" " " "	"
E-143-ROH	17 May 60	79	800	48,326	494 W	Development launcher range tables.	Satisfactory.
E-144-ROH	17 May 60	76	800	48,620	710 W	" " " "	"
E-145-RGH	18 May 60	77	900	40,565	722 E	Develop warhead function & reliability.	Satisfactory.
E-146-RGH	24 May 60	77	600	40,268	248 E	Develop warhead function & reliability.	Satisfactory.
E-147-ROH	25 May 60	-32	400	29,493	231 W	Development launcher range tables.	Satisfactory.
E-148-ROH	25 May 60	-34	400	29,253	311 W	" " " "	"
E-149-ROH	26 May 60	-34	400	29,297	450 W	Development launcher range tables.	Satisfactory.
E-150-ROH	26 May 60	-33	400	29,219	277 W	" " " "	"
E-151-RML	26 May 60	76	309	24,379	94 W	Development function and accuracy.	Satisfactory.
E-152-ROH	1 Jun 60	76	200	18,690	135 W	Development launcher range tables.	Satisfactory.
E-153-ROH	1 Jun 60	76	200	18,298	64 W	" " " "	"
E-154-ROH	3 Jun 60	82	200	19,001	301 W	Development launcher range tables.	Satisfactory.
E-155-ROH	3 Jun 60	82	200	18,578	356 W	" " " "	"
E-156-ROH	3 Jun 60	121	400	31,063	199 W	Development launcher range tables.	Satisfactory.
E-157-ROH	3 Jun 60	123	400	31,481	826 W	" " " "	"
E-158-UML	7 Jun 60	77	731	------	-------	User warhead function & reliability.	Satisfactory.
E-159-RMX	7 Jun 60	80	498	32,160	612 E	Develop warhead function & reliability.	Satisfactory.
E-160-ROX	7 Jun 60	80	200	19,643	430 W	Development launcher range tables.	Satisfactory.
E-161-ROX	7 Jun 60	78	200	19,664	265 W	" " " "	"
E-162-ROH	8 Jun 60	18	400	30,600	479 W	Development launcher range tables.	Satisfactory.
E-163-ROH	8 Jun 60	17	400	30,319	205 E	" " " "	"
E-164-ROX	9 Jun 60	76	200	19,096	444 W	Development launcher range tables.	Satisfactory.
E-165-ROX	9 Jun 60	77	200	19,046	515 W	" " " "	"
E-166-ROH	13 Jun 60	75	800	45,724	345 E	Development launcher range tables.	Satisfactory.
E-167-ROH	13 Jun 60	76	800	45,671	219 E	" " " "	"
E-168-RML	13 Jun 60	29	356	25,569	511 E	Develop warhead function & reliability.	Satisfactory.
E-169-UML	14 Jun 60	77	730	40,268	248 E	User warhead function & reliability.	Satisfactory.
E-170-ROX	14 Jun 60	77	400	30,657	828 W	Develop launcher range tables.	Satisfactory.
E-171-ROH	15 Jun 60	16	400	30,591	904 W	Develop launcher range tables.	Satisfactory.
E-172-ROH	15 Jun 60	16	400	30,163	122 E	" " " "	"

*In yards.

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TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET - Continued
June 1958 — December 1962

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact* Range	Actual Impact* Deflect	Objectives	Remarks
E-173-ROX	16 Jun 60	77	800	45,038	1,041 W	Develop launcher range tables.	Satisfactory.
E-174-ROX	16 Jun 60	77	800	45,213	905 W	" " " "	Satisfactory.
E-175-ROX	16 Jun 60	123	400	28,201	409 W	" " " "	Short Range.
E-176-ROX	16 Jun 60	119	400	30,307	427 W	" " " "	Satisfactory.
E-177-ROX	16 Jun 60	79	800	46,007	1,115 E	" " " "	Satisfactory.
E-178-ROX	16 Jun 60	80	800	45,991	735 E	" " " "	Satisfactory.
E-179-ROX	17 Jun 60	84	400	31,085	496 W	" " " "	Satisfactory.
E-180-ROX	17 Jun 60	83	400	20,952	352 W	" " " "	Satisfactory.
E-181-ROX	24 Jun 60	-30	400	29,888	448 W	" " " "	Satisfactory.
E-182-ROX	24 Jun 60	-30	400	29,860	57 E	" " " "	Satisfactory.
E-183-RMX	27 Jun 60	76	267	20,952	352 W	Develop warhead function & reliability.	Satisfactory.
E-184-EOH	27 Jun 60	77	800	46,108	576 W	Engineer accuracy & reliability with	Satisfactory.
E-185-EOH	27 Jun 60	77	800	45,717	306 W	the XM-33 launcher.	Satisfactory.
E-186-EDL	30 Jun 60	-28	400	25,692	45 E	Launcher accuracy & reliability.	Satisfactory.
E-187-EDL	30 Jun 60	-27	400	25,868	252 W	" " " "	Satisfactory.
E-188-RMX	5 Jul 60	77	498	31,934	483 W	Develop warhead function and	Satisfactory.
E-189-RMX	5 Jul 60	77	622	35,706	461 W	reliability.	Satisfactory.
E-190-EOH	6 Jul 60	76	200	18,013	233 W	Launcher accuracy & reliability.	Satisfactory.
E-191-EOH	6 Jul 60	77	200	17,560	185 W	" " " "	Satisfactory.
E-192-ROX	12 Jul 60	120	400	------	-----	Develop launcher range tables.	Motor failure.
E-193-ROL	4 Aug 60	120	400	------	-----	Development firing with XM31E3 motor (hollow sliver).	Motor failure.
E-194-ROL	22 Aug 60	120	400	30,116	1,873	Development firing with XM31E3 motor (solid sliver).	Successful. Missile followed trajectory to target.
E-195-ROL	6 Sep 60	120	400	30,776	24 W	Evaluate XM31E3 motor performance and	Satisfactory.
E-196-ROL	6 Sep 60	120	400	30,403	324 W	obtain firing table data.	Satisfactory.
E-197-ROL	8 Sep 60	120	400	29,688	556 W	" " " " "	"
E-198-ROL	8 Sep 60	120	400	30,370	254 W	" " " " "	"
E-199-ROL	21 Sep 60	-30	400	28,496	10 E	" " " " "	"
E-200-ROL	21 Sep 60	-30	400	28,974	101 W	" " " " "	"
E-201-ROX	23 Sep 60	76	200	20,027	414 W	Evaluate XM31E3 motor performance, obtain firing table data, and determine rocket-launcher compatibility.	Rocket E-201-ROX hung fire for 4 seconds before a successful test. Rocket E-202-ROX impacted 2,100 meters short. Premature initiation of spin rockets.
E-202-ROX	23 Sep 60	77	200	16,972	279 W		
E-203-ROX	28 Sep 60	120	400	------	-----	Evaluate XM31E3 motor performance, obtain firing table data, and determine rocket-launcher compatibility.	Rocket exploded 2-1/2 seconds after firing.
E-204-ROL	18 Oct 60	103	400	30,495	25 W	Evaluate performance & accuracy of	Satisfactory.
E-205-ROL	18 Oct 60	103	400	29,907	317 W	rocket when conditioned at +100°F.	"
E-206-ROL	21 Oct 60	103	400	29,911	272 W	" " " " "	"
E-207-ROL	21 Oct 60	103	400	30,712	149 E	" " " " "	"
E-208-RAL SLIM JOHN	8 Nov 60	99	383	30,306	760 W	Obtain over-acceleration information for the XM31E3 motor. Rocket was conditioned at +103°F.	The rocket functioned satisfactorily.

*In yards.

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TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET - Continued
June 1958 — December 1962

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact* Range	Actual Impact* Deflect	Objectives	Remarks
E-209-ROL	21 Nov 60	99	400	29,342	47 E	Evaluate performance of rockets at 100°F. Rockets conditioned at 103°F.	Rockets functioned satisfactorily.
E-210-ROL	21 Nov 60	100	400	29,657	73 W		" " "
E-211-ROL	28 Nov 60	101	400	29,313	13 E	" " " " "	" " "
E-212-ROL	28 Nov 60	102	400	28,760	73 W	" " " " "	" " "
E-213-ROL	30 Nov 60	101	400	29,765	9 E	" " " " "	" " "
E-214-ROL	30 Nov 60	99	400	29,532	19 W	" " " " "	" " "
E-215-RMX	3 Jan 61	75	327	23,651	243 W	Determine the XM-50 rocket-XM76 warhead performance and the rocket-launcher compatibility.	Rocket, launcher, and warhead performed satisfactorily.
E-216-ROL	11 Jan 61	97	200	17,545	224 W	Verify rocket performance at +100°F.	Rockets performed satisfactorily.
E-217-ROL	11 Jan 61	99	200	17,496	230 W	" " " " "	" " "
E-218-ROL	13 Jan 61	100	200	17,581	331 W	" " " " "	" " "
E-219-ROL	18 Jan 61	100	200	17,918	153 W	" " " " "	" " "
E-220-ROL	18 Jan 61	100	200	17,968	41 W	" " " " "	" " "
E-221-ROL	23 Jan 61	100	200	17,841	29 W	" " " " "	" " "
E-222-ROL	23 Jan 61	99	200	17,788	92 E	" " " " "	" " "
E-223-ROX	3 Feb 61	76	400	30,268	246 W	Determine compatibility of the XM-50 rocket with the M289 launcher.	Rockets and launchers functioned satisfactorily.
E-224-ROX	3 Feb 61	67	400	30,357	39 W		
E-225-RGX	8 Feb 61	74	900	48,172	665 E	Secure E19R2 warhead development data.	Rocket/warhead functioned satisfactorily.
E-226-RMX	13 Feb 61	77	134	6,442	5 E	Secure warhead development data for the rocket-warhead combination.	Rockets, warheads, and launchers performed satisfactorily.
E-227-RMX	13 Feb 61	75	135	6,608	176 E		
E-228-RMX	13 Feb 61	77	371	9,814	157 E		
E-229-RMX	13 Feb 61	75	370	9,772	187 E		
E-230-ROH	15 Feb 61	-31	200	18,179	217 W	Determine compatibility of the rocket and XM33 launcher.	Rockets and launchers performed satisfactorily.
E-231-ROH	15 Feb 61	-31	200	17,497	324 W		
E-232-ROH	16 Feb 61	117	200	19,305	307 W	Determine rocket-launcher compatibility and qualify rocket operation at +120°F.	Rockets and launchers performed satisfactorily.
E-233-ROH	16 Feb 61	114	200	18,805	405 W		
E-234-ROH	20 Feb 61	118	200	18,868	620 W	" " " "	" " " "
E-235-ROH	20 Feb 61	120	200	18,379	556 W	" " " "	" " " "
E-236-ROX	24 Feb 61	116	200	18,438	92 W	Determine rocket-launcher compatibility and qualify rocket operation at 120°F.	Rockets and launchers performed satisfactorily.
E-237-ROX	24 Feb 61	115	200	18,034	259 W		
E-238-UML	28 Feb 61	42	396	28,343	13 E	Determine the performance and accuracy of the rocket-warhead combination.	Rockets, warheads, and launchers performed satisfactorily.
E-240-UML	28 Feb 61	48	675	------	-------		
E-239-RMX	28 Feb 61	78	310	------	-------	" " " " "	" " " "
E-241-ROX	8 Mar 61	75	800	44,158	135 E	Secure data on the compatibility of XM-50 rocket with M289 launcher.	Rockets and launchers performed satisfactorily.
E-242-ROX	8 Mar 61	76	800	43,788	317 E		
E-243-ROX	13 Mar 61	79	200	18,193	281 W	" " " " " "	" " " "
E-244-ROX	13 Mar 61	79	200	18,448	193 W	" " " " " "	" " " "
E-245-RGX	21 Mar 61	75	400	29,317	81 W	Secure E19R2 warhead development data.	Rockets, launchers, and warheads performed satisfactorily.
E-246-RGX	21 Mar 61	72	400	29,238	792 E	" " " " "	
E-247-EOX	31 Mar 61	75	400	29,772	354 W	Determine the accuracy, reliability, suitability, and adequacy of the improved system.	Rockets and launchers performed satisfactorily.
E-248-EOX	31 Mar 61	76	400	29,550	186 W		

*In yards.

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TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET - Continued
June 1958 — December 1962

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact* Range	Deflect	Objectives	Remarks
E-249-EMH E-250-EMH	3 Apr 61 3 Apr 61	78 77	800 800	39,966 40,602	153 E 1,104 E	Determine accuracy & reliability of the system & compatibility & suitability of the T2044 warhead with the system.	Rockets and warheads performed satisfactorily.
E-251-RGH	27 Apr 61	77	900	47,712	293 W	Determine suitability & adequacy of the chemical warhead for the improved system.	Launcher, rocket, and warhead performed satisfactorily.
E-252-EPH E-253-EPH	4 May 61 4 May 61	-27 -28	200 200	18,050 18,144	1,162 W 825 W	Determine accuracy, reliability, and adequacy of the improved system and investigate the effect of the XM-38 warhead on system accuracy.	Rockets performed satisfactorily. Warhead event occurred at the proper time; however, the nose tip was blown off.
E-254-APL E-255-APL	16 May 61 16 May 61	98 100	400 400	27,948 28,061	1,484 W 1,089 W	Determine quality & reliability of production rockets in the first two QA firings.	Rockets performed satisfactorily.
SJ- 5-ROH	1 Jun 61	123	200	22,347	735 W	Obtain over-acceleration performance data for the XM-50 rocket motor.	Rocket performed satisfactorily.
SJ- 6-ROL	2 Jun 61	80	800	74,771	2,164 W	Obtain over-acceleration data for the XM-50 program. The rocket was fired from the M386 launcher.	Rocket performed satisfactorily.
E-256-EMH E-257-EMH	8 Jun 61 8 Jun 61	-30 -30	200 299	14,849 16,484	551 E 125 E	Determine system reliability & suitability of the T2044 warhead for use with the XM-50 system.	Rocket performed satisfactorily.
SJ- 7-ROH	9 Jun 61	125	200	20,981	450 W	Obtain over-acceleration performance data for the XM-50 rocket motor.	Rocket performed satisfactorily.
SJ- 8-ROH SJ- 9-ROH	13 Jun 61 13 Jun 61	120 120	200 200	24,376 23,582	719 W 170 E	Obtain over-acceleration performance data on the XM-50 motor using the over-acceleration HJ configuration.	Satisfactory performance.
E-258-EOH E-259-EOH	20 Jun 61 20 Jun 61	76 78	400 400	30,168 30,011	149 W 163 W	Determine accuracy, reliability, suitability, & adequacy of the improved system.	Rockets performed satisfactorily.
E-260-RML	28 Jun 61	77	327	22,929	146 E	Obtain a 1,280-meter airburst and an 18,400-meter range for determining the performance & accuracy of the XM-50 rocket & XM-76 warhead combination.	Satisfactory performance.
E-261-APL E-262-APL	29 Jun 61 29 Jun 61	102 102	400 400	27,995 27,903	898 E 416 E	Determine the quality and reliability of the XM-50 rocket.	Rockets and warheads performed satisfactorily.
E-263-EMH E-264-EMH	7 Jul 61 7 Jul 61	-29 119	40 400	27,071 28,009	429 W 167 E	Determine accuracy & reliability of the XM-50 system and the compatibility & suitability of the T2044 warhead for use with the system.	Rockets and warheads functioned satisfactorily.
E-265-RMH E-266-RMH	10 Jul 61 10 Jul 61	80 79	323 325	20,275 22,036	6,691 E 6,877 E	Check performance & accuracy of the XM-50 rocket-XM76 warhead combination. Firings were conducted from an uprange site to provide impact within the optimum recovery area.	Rockets and warheads functioned satisfactorily

*In yards.

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TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET - Continued
June 1958 — December 1962

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact* Range	Actual Impact* Deflect	Objectives	Remarks
E-267-USL	11 Jul 61	84	184	------	-------	Determine the reliability, accuracy & ballistic performance of the XM-48 warhead-XM-50 rocket combination.	The spin rockets on round E-267-USL functioned prematurely after approximately 3 to 6 inches of rocket travel. E-268-USL functioned satisfactorily.
E-268-USL	11 Jul 61	82	137	------	-------		
E-269-USL	12 Jul 61	86	233	20,192	135 W	Determine the reliability, accuracy and ballistic performance of the XM-48 warhead-XM-50 rocket combination.	Rocket and warhead functioned satisfactorily.
E-270-USL	12 Jul 61	82	229	19,666	265 E		
E-271-USL	13 Jul 61	86	603	37,327	983 W		
E-272-USL	13 Jul 61	86	613	37,816	32 E	" " " "	" " " "
E-273-EMH	24 Jul 61	-31	800	------	-------	Determine accuracy & reliability of the XM-50 system and the compatibility & suitability of the T2044 warhead.	Rockets and warheads functioned satisfactorily.
E-274-EMH	24 Jul 61	116	800	39,129	817 E		
E-275-UPL	25 Jul 61	84	248	19,025	130 W	Determine reliability, accuracy, and ballistic performance of the XM-38 warhead-XM-50 rocket combination.	Rockets and warheads functioned satisfactorily.
E-276-UPL	25 Jul 61	87	248	19,955	382 W		
E-277-UPL	28 Jul 61	87	397	27,864	62 E		" " " "
E-278-UPL	28 Jul 61	89	394	27,709	471 E	" " " "	" " " "
E-279-UPL	31 Jul 61	87	567	34,104	70 E	" " " "	" " " "
E-280-UPL	31 Jul 61	84	560	------	-------	" " " "	" " " "
E-281-EMH	1 Aug 61	77	400	27,991	478 W	Determine system accuracy & reliability and T2044 warhead compatibility and suitability.	Successful.
E-282-EMH	1 Aug 61	77	400	28,019	569 W		
E-283-RML	9 Aug 61	84	243	23,274	147 W	Check performance & accuracy of rocket-warhead combination. [An XM-76 warhead was used instead of the T2044.]	The warhead functioned satisfactorily.
E-284-EMH	15 Aug 61	77	200	16,280	308 W	Determine system accuracy & reliability and evaluate the T2044 warhead.	Heavy concrete ballast replaced theT2044 warhead on E-285-EDH because the T2044 warhead had been damaged during operational tests. All required data were obtained.
E-285-EDH	15 Aug 61	77	200	15,583	361 W		
E-286-RGH	1 Sep 61	80	320	23,621	233 E	Determine suitability and adequacy of the E19R2 chemical warhead for use with the XM-50 rocket.	Rocket, launcher, and warhead functioned as planned.
E-287-PPL	1 Sep 61	79	400	27,590	509 W	Determine the quality & reliability of the production XM-50 round.	The practice warheads functioned as planned and all required data were obtained, but both pedestal doors on rocket E-291-PPL were ejected after the spin rocket functioned.
E-288-PPL	1 Sep 61	78	400	27,278	376 W		
E-289-PPL	7 Sep 61	79	400	27,398	375 W	" " " " " "	
E-290-PPL	7 Sep 61	78	400	27,313	203 W	" " " " " "	
E-291-PPL	7 Sep 61	76	400	26,850	65 E	" " " " " "	" " " " "
E-292-PPL	7 Sep 61	76	400	26,865	24 W	" " " " " "	" " " " "
E-293-EMH	13 Sep 61	71	194	15,226	339 E	Determine the compatibility & suitability of the warhead for use with the XM-50 system.	The warhead functioned as planned.

*In yards.

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TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET - Continued
June 1958 — December 1962

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact* Range	Deflect	Objectives	Remarks
E-294-PPL E-295-PPL E-296-PPL E-297-PPL	18 Sep 61 18 Sep 61 20 Sep 61 20 Sep 61	78 77 77 76	400 400 400 400	27,919 27,541 27,222 27,144	505 W 744 W 1,066 W 1,066 W	Determine the effects on performance of production engineering changes to the XM66E1 motor. XM58E1 igniters were modified to prevent the blowout of squib lead screws which occurred when rockets E-291-PPL and E-292-PPL were fired.	All required data were obtained. Warheads were equipped with inert fuzes.
E-298-APL E-299-APL	21 Sep 61 21 Sep 61	77 76	400 400	27,756 26,684	764 W 246 W	Determine the quality & reliability of the production XM-50 round. The XM-38 warhead/T-2075E1 fuzes were set to function at 47.0 seconds.	Warhead spotting charges functioned as planned all all required data were obtained.
E-300-RGL E-301-RGL	25 Sep 61 25 Sep 61	69 77	600 600	------ ------	------- -------	Provide adequacy of the chemical warhead (E19R2) for the XM-50 rocket. Fuzes were set to obtain events at 66.7 and 73.1 seconds and burst heights of 1,219 and 2,438 meters, respectively.	The warheads functioned satisfactorily. Both rounds impacted at approximately 79.3 seconds, 35,600 meters from the launcher.
E-302-APL E-303-APL	28 Sep 61 28 Sep 61	74 76	400 400	25,595 25,392	8.2 R 9.6 R	Determine the quality and reliability of the production XM-50 round. The XM-38 warhead/T-2075E1 fuzes were set to function at 47.0 seconds.	Warhead spotting charges functioned as planned and all required data were obtained.
E-304-RML E-305-RML	2 Oct 61 2 Oct 61	76 73	337 360	------ ------	------- -------	Check the performance and accuracy of the XM-50 rocket-XM-76 warhead combination. The rounds were aimed to obtain airbursts at 1,280 and 1,677 meters, 18,400 meters from the launcher.	The warheads functioned as intended and all required data were obtained.
E-306-EMH	3 Oct 61	60	195	------	-------	Determine the compatibility & suitability of the T2044 warhead for use with the XM-50 system. The round was aimed to obtain an airburst at 320 meters, 12,025 meters from the launcher.	The warhead functioned as intended and all required data were obtained.
E-307-EMH	24 Oct 61	62	382	------	-------	Determine compatibility & suitability of the T2044 warhead for use with the XM-50 system. The round was aimed to obtain an airburst at 800 meters, 23,690 meters from the launcher.	The warhead functioned normally and all required data were obtained.
E-308-APL E-309-APL	26 Oct 61 26 Oct 61	-20 -31	400 400	24,962 23,991	7.0 R 12.7 R	Determine the quality and reliability of the production XM-50 rocket. The fuzes were set to obtain events at 47.0 seconds.	The warhead spotting charges functioned as intended and all required data were obtained.
E-310-APL E-311-APL	27 Oct 61 27 Oct 61	-20 -30	400 400	24,095 24,019	10.4 R 10.6 R	Determine the quality & reliability of the production XM-50 rocket. The XM-38/T-2075E1 fuzes were set to function at 47.0 seconds.	The warhead spotting charges functioned as intended and all required data were obtained.

*Rounds E-294-PPL thru E-301-RGL in yards.
Rounds E-302-APL thru E-311-APL in meters-mils, respectively.

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TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET - Continued
June 1958 — December 1962

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact* Range	Actual Impact* Deflect	Objectives	Remarks
E-312-APL	16 Nov 61	100	400	25,766	20.5 R	Determine the quality & reliability of the production XM-50 rocket. The XM-38/T2075E1 fuzes were set to function at 48.8 seconds.	The spotting charges and warhead functioned as intended and all required data were obtained.
E-313-APL	16 Nov 61	100	400	25,288	4.2 R		
E-314-APL	17 Nov 61	101	400	26,053	49.3 R		
E-315-APL	17 Nov 61	100	400	25,841	43.5 R		
E-316-RML	20 Nov 61	65	337	------	-------	Check the performance and accuracy of the XM-50 rocket-XM-76 warhead combination. The rockets were aimed to obtain airbursts at a height of 1,280 meters and a horizontal range of 18,400 meters.	The warheads functioned as intended and all required data were obtained.
E-317-RML	20 Nov 61	69	335	------	-------		
E-318-EMH	21 Nov 61	53	383	------	-------	Determine the compatibility & suitability of the T2044 warhead for use with the XM-50 system. The rocket was aimed to obtain an airburst at a horizontal range of 23,690 meters.	The warhead functioned as intended and all required data were obtained.
E-319-APL	3 Jan 62	77	400	24,232	31.5 L	Determine the quality and reliability of the production XM-50 rocket.	Satisfactory performance.
E-320-APL	3 Jan 62	77	400	24,804	39.2 L		" "
E-321-APL	3 Jan 62	77	400	24,603	39.0 L	" " " " "	" "
E-322-APL	3 Jan 62	76	400	24,746	25.2 L	" " " " "	" "
E-323-EMH	30 Jan 62	46	817	------	-------	----------	----------
E-324-RML	30 Jan 62	64	331	------	-------	----------	----------
E-325-UGH	5 Feb 62	51	304	------	-------	----------	----------
E-326-UGH	7 Feb 62	62	314	------	-------	----------	----------
E-327-UGH	12 Feb 62	62	169	------	-------	----------	----------
E-329-UGH	12 Feb 62	64	225	------	-------	----------	----------
E-328-RML	12 Feb 62	73	330	------	-------	----------	----------
E-330-APL	23 Feb 62	-30	400	23,935	11.2 L	Determine the quality & reliability of the production XM-50 rockets.	----------
E-331-APL	23 Feb 62	-28	400	24,005	16.7 L		
E-332-UGH	23 Feb 62	46	582	------	-------	----------	----------
E-333-EMH	26 Feb 62	55	714	------	-------	----------	----------
E-334-UGH	26 Feb 62	54	507	------	-------	----------	----------
E-335-APL	27 Feb 62	-30	400	24,436	25.4 L	Determine the quality & reliability of the production XM-50 rocket.	----------
E-336-APL	27 Feb 62	-28	400	24,548	39.8 L		
E-337-PPL	28 Feb 62	-29	400	------	-------	----------	----------
E-338-PPL	28 Feb 62	-27	400	------	-------	----------	
E-339-RGL	22 Mar 62	59	509	------	-------	----------	----------
E-340-APL	26 Mar 62	76	400	24,952	7.7 L	Determine the quality & reliability of the production XM-50 rockets.	----------
E-341-APL	26 Mar 62	77	400	24,999	3.5 R		
E-342-APL	27 Mar 62	78	400	25,665	7.8 L	Determine the quality & reliability of the production XM-50 rockets.	----------
E-343-APL	27 Mar 62	77	400	25,218	10.5 L		
E-344-APL	28 Mar 62	77	400	25,183	51.1 L	Determine the quality & reliability of the production XM-50 rocket.	----------
E-345-APL	2 Apr 62	77	400	25,613	1.4 L	Determine the quality & reliability of the production XM-50 rocket.	----------
E-346-APL	3 Apr 62	77	400	25,271	11.7 L	Determine the quality & reliability of the production XM-50 rockets.	----------
E-347-APL	3 Apr 62	77	400	25,172	8.6 L		

*In meters-mils.

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TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET - Continued
June 1958 — December 1962

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact* Range	Deflect	Objectives	Remarks
E-348-RML	11 Apr 62	65	363	------	-------	----------------------------------	--
E-349-APL	12 May 62	99	400	26,471	17.4 L	Determine the quality and reliability	--
E-350-APL	12 May 62	100	400	26,373	35.4 L	of the production XM-50 Rockets.	
E-351-RML	22 May 62	70	367	------	-------	----------------------------------	--
E-352-APL	23 May 62	-28	400	24,470	4.3 R	Determine the quality and reliability	--
E-353-APL	23 May 62	-26	400	24,725	4.1 R	of the production XM-50 rockets.	
E-354-ROL	22 Jun 62	74	257	------	-------	----------------------------------	--
E-355-EPL	28 Jun 62	-23	200	------	-------	Determine the IHJ system accuracy, reliability, and suitability for field use.	--
E-356-EPL	2 Jul 62	118	200	------	-------	Determine the IHJ system accuracy, reliability, and suitability for field use.	--
E-357-ESL	16 Jul 62	118	200	------	-------	Determine the IHJ system accuracy, reliability, and suitability for field use.	--
E-358-EPL	16 Jul 62	119	200	------	-------		--
E-359-ESL	18 Jul 62	-30	200	------	-------		--
E-360-EPL	18 Jul 62	118	200	------	-------	" " " " "	--
E-361-EPL	20 Jul 62	-30	200	------	-------	" " " " "	--
E-362-ESL	20 Jul 62	-30	200	------	-------	" " " " "	--
E-363-ESL	23 Jul 62	116	800	------	-------	" " " " "	--
E-364-EPL	23 Jul 62	-32	800	------	-------	" " " " "	--
E-365-APL	24 Jul 62	-28	400	24,099	2.3 R	Determine the quality and reliability	Warhead event malfunction.
E-366-APL	24 Jul 62	-29	400	24,992	0.2 L	of the production XM-50 rockets.	Satisfactory performance.
E-367-EPL	25 Jul 62	-31	200	------	-------	Determine the IHJ system accuracy, reliability, and suitability for field use.	--
E-368-APL	25 Jul 62	98	400	25,860	9.0 L	Determine quality and reliability of production XM-50 rockets.	--
E-369-ESL	27 Jul 62	-32	200	------	-------	Determine the IHJ system accuracy,	--
E-370-ESL	27 Jul 62	115	200	------	-------	reliability, and suitability for field use.	--
E-371-APL	28 Jul 62	103	400	25,241	19.2 L	Determine the quality and reliability of production XM-50 rockets.	--
E-372-APL	30 Jul 62	101	400	25,150	0.4 R	" " " " "	--
E-373-ESL	3 Aug 62	118	800	------	-------	Determine the IHJ system accuracy, reliability, and suitability for field use.	--
E-374-EPL	3 Aug 62	112	800	------	-------		--
E-375-RML	7 Aug 62	58	367	------	-------	----------------------------------	--
E-376-EPL	8 Aug 62	-34	800	------	-------	Determine the IHJ system accuracy, reliability, and suitability for field use.	--
E-377-ESL	8 Aug 62	116	800	------	-------		--
E-378-EPL	9 Aug 62	-32	800	------	-------	" " " " "	--
E-379-ESL	9 Aug 62	-28	800	------	-------	" " " " "	--

*In meters-mils.

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TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET - Continued
June 1958 — December 1962

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact Range	Actual Impact Deflect	Objectives	Remarks
E-380-ESL	10 Aug 62	-32	800	------	-------	Determine the IHJ system accuracy, reliability, and suitability for field use.	--
E-381-EPL	10 Aug 62	117	800	------	-------		--
E-382-ESL	10 Aug 62	117	200	------	-------		--
E-383-ESL	15 Aug 62	-34	800	------	-------	" " " " "	--
E-384-EPL	15 Aug 62	118	800	------	-------	" " " " "	--
E-385-RPX	17 Aug 62	-33	800	------	-------	--	--
E-386-ESX	17 Aug 62	118	800	------	-------	Determine the IHJ system accuracy, reliability, and suitability for field use.	--
E-387-ESX	22 Aug 62	-31	800	------	-------		--
E-388-EPX	22 Aug 62	116	800	------	-------	" " " " "	--
E-389-EPX	24 Aug 62	-28	800	------	-------	" " " " "	--
E-390-ESX	24 Aug 62	118	800	------	-------	" " " " "	--
E-391-EPX	28 Aug 62	-32	200	------	-------	" " " " "	--
E-392-ESX	28 Aug 62	-29	800	------	-------	" " " " "	--
E-393-EPX	7 Sep 62	117	800	------	-------	" " " " "	--
E-394-ESH	7 Sep 62	117	800	------	-------	" " " " "	--
E-395-EPH	10 Sep 62	-30	800	------	-------	" " " " "	--
E-396-EPH	10 Sep 62	118	800	------	-------	" " " " "	--
E-397-ESH	17 Sep 62	-26	800	------	-------	" " " " "	--
E-398-EPH	19 Sep 62	-30	800	------	-------	" " " " "	--
E-399-ESH	19 Sep 62	117	800	------	-------	" " " " "	--
E-400-ESH	20 Sep 62	-32	800	------	-------	" " " " "	--
E-401-EPX	20 Sep 62	-30	200	------	-------	" " " " "	--
E-402-EPH	21 Sep 62	117	800	------	-------	" " " " "	--
E-403-ESX	21 Sep 62	-27	200	------	-------	" " " " "	--
E-404-ESX	25 Sep 62	-33	200	------	-------	" " " " "	--
E-405-ESH	9 Oct 62	118	200	------	-------	" " " " "	--
E-406-EPH	9 Oct 62	118	200	------	-------	" " " " "	--
E-407-ESH	11 Oct 62	-32	200	------	-------	" " " " "	--
E-408-EPH	11 Oct 62	-32	200	------	-------	" " " " "	--
E-409-ESH	15 Oct 62	79	400	------	-------	" " " " "	--
E-410-EPH	15 Oct 62	78	400	------	-------	" " " " "	--
E-411-EPX	30 Oct 62	115	200	------	-------	" " " " "	--
E-412-EOX	30 Oct 62	116	200	------	-------	" " " " "	--
E-413-RML	2 Nov 62	66	364	------	-------	--	--

TABLE VIII—INTEGRATED TEST PROGRAM: XM-50 ROCKET - Continued
June 1958 — December 1962

Round Numbers	Dates Fired	GT (°F.)	QE (Mils)	Actual Impact* Range	Actual Impact* Deflect	Objectives	Remarks
E-414-APL	14 Nov 62	77	400	24,702	0.2 L	Establish production quality and	--
E-415-APL	14 Nov 62	77	400	25,128	14.7 L	reliability of the IHJ XM-50 rocket.	--
E-416-APL	14 Nov 62	76	400	25,364	17.6 L	" " " "	--
E-417-APL	14 Nov 62	78	400	25,792	22.8 L	" " " "	--
E-418-APL	19 Nov 62	118	400	22,782	1.3 L	" " " "	--
E-419-APL	19 Nov 62	118	400	23,817	2.0 R	" " " "	--
E-420-RML	14 Dec 62	53	371	------	-------	--	--

*In meters-mils.

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Honest John Missile System Monthly Progress Reports (RCS: ORDXM-C 1004), March 1959 - November 1959

Monthly Progress Report for Ordnance Project TW-200 - Honest John - January 1960 - November 1960

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William R. Stevenson, Eunice H. Brown, et al., "History of White Sands Missile Range, 1 July - 31 December 1961" (2 vols., WSMR, 10 May 1962)

C. R. Poisall, Eunice H. Brown, et al., "White Sands Missile Range Annual Historical Report, 1958" (2 vols., WSMR, 1 June 1959)

White Sands Missile Range Final Data Reports - XM-50 Rocket (Improved Honest John), October 1959 - June 1960

Honest John Firing Ledger, Littlejohn Commodity Office, MICOM

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APPENDIX B

LIST OF IMPROVED HONEST JOHN CONTRACTS—JUNE 1955 - SEPTEMBER 1964
(Organized by date of contract)

Name of Contractor	Contract Data			Date		Task or Item	Type Funds	Total Dollar Value
	Number	Date	Type	Del Cp	Fin Pt			
Douglas Aircraft Company	DA-04-495-ORD-673	Jun 55	CPFF	Apr 61	Mar 62	Res & Design HJ Rkt	R&D	$ 898,911
Douglas Aircraft Company	DA-04-495-ORD-693	Jun 55	CPFF	Dec 59	Dec 62	HJ Imprv - Phase I	R&D	1,731,338
Emerson Electric Manufacturing Co.	DA-1021-ORD-4979(Z)	Aug 56	CPFF	Jun 59	Nov 63	Engr Rkt Mtr Mtl Parts	R&D	2,207,978
Consol Avionics & Consol Diesel El	DA-30069-ORD-2441	Jun 58	FFP	Unk	Jan 60	Instrumentation Unit	P&P	340,484
Douglas Aircraft Company	DA-4495-ORD-1391	Dec 58	CPFF	Apr 60	Jan 63	Res & Dev IHJ Msl	R&D	1,292,822
Emerson Electric Manufacturing Co.	DA-23072-ORD-1384(Z)	Dec 58	CPFF	Sep 61		Res & Dev IHJ Prog	R&D	2,229,658
Emerson Electric Manufacturing Co.	DA-23072-ORD-1471	Jun 59	CPFF	Unk	Unk	Preprod Engr on XM50	P&P	212,999
Emerson Electric Manufacturing Co.	DA-23072-ORD-1516(Z)	Dec 59	CPFF	Jan 61		XM50 Metal Parts	P&P	1,230,402
Douglas Aircraft Company	DA-1009-ORD-854(Z)	Apr 60	CPFF	Dec 61	Sep 64	wnd Inc XM50 Airframe Comp	P&P	2,421,221
Douglas Aircraft Company	DA-1009-ORD-861(Z)	Apr 60	CPFF	Jun 62		Cont'd R&D Efforts on IHJ	R&D	771,020
Douglas Aircraft Company	DA-1009-ORD-863(Z)	May 60	CPFF	Sep 60	Sep 64	XM50 Airframe Components	R&D	37,811
Emerson Electric Manufacturing Co.	DA-23072-ORD-1555(Z)	May 60	CPFF	Jun 62		2nd Inc XM50 Mtr Mtl Parts	P&P	13,352,165
Douglas Aircraft Company	DA-1009-ORD-835(Z)	Jun 60	CPFF	Oct 60	Sep 64	XM50 Metal Parts	P&P	426,444
Douglas Aircraft Company	DA-1009-ORD-978(Z)	Jun 61	FPRD	Nov 62		Flight Hardward IHJ50 w/o Whd	P&P	10,701,157
Douglas Aircraft Company	DA-1009-ORD-1007(Z)	Oct 61	CPFF			Engr Svcs Rkt 762-mm.	P&P	62,179
Emerson Electric Manufacturing Co.	DA-23072-ORD-1571(Z)	Nov 61	CPFF	Jan 62		Production Engr Sty	P&P	636,703
Emerson Electric Manufacturing Co.	DA-23072-ORD-1720(Z)	Nov 61	CPFF	Nov 64		Prod Engr & Qual Assu	P&P	886,707
Emerson Electric Manufacturing Co.	DA-23072-ORD-1698(Z)	Dec 61	FPRD	May 62		Rockets XM50 Mtr Mtl Parts	P&P	2,333,085
Emerson Electric Manufacturing Co.	DA-23072-ORD-1757	Mar 62	FFP	Sep 62	Nov 63	Lock, Rkt Mtr Igniter	P&P	50,869
Atlas Industries, Incorporated	DA-33019-ORD-3912	Mar 62	FFP		May 64	Spin Rocket	P&P	94,869
American Machine & Foundry Company	DA-30069-ORD-3578(Z)	Mar 62	FFP	Nov 63	May 64	Pedestal Fin & Fairings	P&P	1,221,566
Ramsey Kantz	DA-1021-ORD-12948	Apr 62	FFP	Sep 62	Oct 62	Tng Dev Shipping Containers	P&P	52,591
Hicks Corporation	DA-1009-ORD-1042(Z)	Apr 62	FFP			Rkt Motor Metal Parts	P&P	2,690,122
Orbitronics, Incorporated	DA-11022-ORD-4187	May 62	FFP	Jan 63	Jan 63	Terminated for Default	P&P	---------
Douglas Aircraft Company	DA-1009-ORD-1048(Z)	May 62	CPFF	May 63		3G77 Training Devices	P&P	654,519
Hicks Corporation	DA-1009-AMC-21(Z)	Jan 63	FFP	Oct 64		Rkt Mtr, XM31E4, Immob Assy, Resonance Supp	P&P	994,955
Emerson Electric Manufacturing Co.	DA-23072-AMC-57(Z)	Jan 63	FFP	Aug 64		Ped Assy XM32E2 Fin w/Fin Cont & Forward Motor	P&P	577,629
Emerson Electric Manufacturing Co.	DA-23072-AMC-58(Z)	Jan 63	FFP	Aug 64		Igniter XM58E1 Parts	P&P	123,783
Atlas Industries, Incorporated	DA-33019-AMC-98(Z)	Jan 63	FFP	Jan 64	Jul 64	Rocket Motor XM37E3	P&P	44,689
Standard Shops, Incorporated	DA-30069-AMC-112(Z)	Feb 63	FFP	Jun 64	Aug 64	Box Shipping & Storage Rocket Motor XM66	P&P	416,806

LIST OF IMPROVED HONEST JOHN CONTRACTS (Continued)

Name of Contractor	Contract Data			Date		Task or Item	Type Funds	Total Dollar Value
	Number	Date	Type	Del Cp	Fin Pt			
Magnesium Aerospace Products, Inc.	DA-20018-AMC-1302(Z)	Feb 63	FFP	Dec 63		Fin & Fin Box 762-mm. Rkt M17	P&P	$ 240,300
Vulcan Metal Fabricators	DA-1021-AMC-10011(Z)	Feb 63	FFP			Box Shipping & Storage Rocket Motor XM66 - Opn 10048370	S&M	250,538
Integrated Electronics Corp.	DA-1021-AMC-10547	Oct 63	FFP			Switch Ignition Opn 10048428	S&M	10,700
Emerson Electric Manufacturing Co.	DA-23062-AMC-185(Z)	Dec 63	FFP			Ped M3A1 Forward Mtr Fairings	P&P	429,210
Emerson Electric Manufacturing Co.	DA-23072-AMC-186	Dec 63	FFP			Rocket Motor M31A1 Inert Pts, Kit, Metal Pts Exp	P&P	1,567,210
Action Manufacturing Co.	DA-36034-AMC-255(Z)	Dec 63	FFP			Metal Parts Assy Igniter MS8A1 - Kit Metal Parts	P&P	128,978
Minneapolis Honeywell Reg. Co., Inc.	DA-28017-AMC-434	Jan 64	CPFF			Development Pal Device, APSA	P&P	314,810
Szemco, Incorporated	DA-1009-AMC-117(Z)	Feb 64	FFP			Rocket Motor M37A1	P&P	83,648
Douglas Aircraft Co.	DA-1021-AMC-11006(Z)	Jun 64	FFP			Rkt Mtr Tng 762-mm., M98	P&P	214,134
Magnesium Aerospace Products, Inc.	DA-1021-AMC-11194(Z)	Jun 64	FFP			Fins w/Containers	P&P	180,432
Action Manufacturing Co.	DA-1021-AMC-11205(Z)	Jun 64	FFP			Igniter M58A1 Metal Parts Assy - Opn 10048444	P&P	77,571
Emerson Electric Manufacturing Co.	DA-1021-AMC-11227(Z)	Jun 64	FFP			Pedestals & Fwd Fairings	P&P	314,229
Milton Machine Corp.	DA-1021-AMC-11186(Z)	Jul 64	FFP			Motor Metal Parts	S&M	66,377
Emerson Electric Manufacturing Co.	DA-1021-AMC-11271(Z)	Jul 64	FFP			Honest John Rocket Motors	P&P	905,152
Minneapolis Honeywell Reg. Co., Inc.	DA-11022-AMC-1034(Z)	Sep 64	FFP			Classified	P&P	4,477,345

Grand Total All Contracts: $ 57,956,116

Total R&D Contracts: $ 9,169,538
Total P&P Contracts: $48,458,963
Total S&M Contracts: $ 327,615 $ 57,956,116

LEGEND: CPFF - Cost Plus Fixed Fee
FFP - Firm Fixed Price
FPRD - Fixed Price Redetermination

SOURCE: Closed Out Contract Listings, AMICOM, 1 Jul 64; and Active Contract Listings, AMICOM, 1 October 1964.

(U) BIBLIOGRAPHICAL NOTE

In the preparation of this volume, the author researched voluminous records in six different collections: (1) the Honest John R&D case files assembled and retired by elements within the Redstone Arsenal complex; (2) the Honest John project files assembled and retired by the Rocket Branch, R&D Division, OCO—generally referred to as the ORDTU Files; (3) a selection of historical reports and diaries in the AMSC Historian's files; (4) a wide range of documents (feasibility and engineering study reports, contractor proposals, Ordnance Technical Committee minutes, etc.) assembled in the Redstone Scientific Information Center; (5) historical studies and reports, copies of supporting documents, and other project materials in the Historical Division files, MICOM; and (6) miscellaneous documents in the current files of the Honest John Commodity Office, MICOM.

The Honest John R&D case files embrace about 19 linear feet of classified and unclassified documents, dating back to 1950. These records are currently stored in the Records Holding Area under the custody of the Records Management Officer, Adjutant Division, U. S. Army Missile Support Command, but will eventually be transferred to the U. S. Army Records Center in St. Louis, Missouri. They include a wide range of material on all phases and facets of the Honest John project—official and personal communications; teletypes; minutes of important conferences and briefings; travel reports; test reports; copies of contracts; periodic progress and status reports; and personal notes of project administrators reflecting candid observations and impressions concerning specific events, actions, problems, etc. Though complete in most respects, these files are not systematically arranged and properly labeled for ready reference, and they generally contain an inordinate number of duplications.

The ORDTU project files generated within the Office, Chief of Ordnance, comprise a valuable set of documents (letters, memoranda,

conference minutes, progress reports, etc.) reflecting program policies and decisions at top management levels, as well as a running account of significant events, actions, and problems. Two boxes of these records were borrowed from the Federal Records Center, Region 3, General Services Administration, in Alexandria, Virginia.

Records located in the AMSC Historian's files embraced about 5 linear feet of historical reports and diaries generated by Redstone Arsenal organizations during the 1950-58 period. Though not used extensively, these records proved useful in filling in gaps and in verifying certain facts, figures, and dates. This particular block of records has since been transferred from AMSC Headquarters to the Records Holding Area, AMSC, for storage and eventual retirement to the U. S. Army Records Center in St. Louis, Missouri.

Of the documents researched in the other three collections, some proved especially useful in rounding out the summary of project activities conducted at distant installations. Among these were the following historical monographs:

> Raymond J. Snodgrass, Organization and Management of the Ordnance Corps, 1945-1958 (Office, Chief of Ordnance, July 1958).
>
> William R. Stevenson, et al., Development and Testing of Rockets and Missiles at White Sands Missile Range, 1956-1960 (WSMR, 27 July 1961).
>
> Neil M. Johnson and Leonard C. Weston, Development and Production of Rocket Launchers at Rock Island Arsenal, 1945-1959 (2 vols., Hq Army Weapons Command, Rock Island, Ill., August 1962).

Supplementary to the mass of written records is the information collected through interviews with persons intimately associated with the Honest John project from its inception. The information assembled through this medium not only filled in gaps and solved obvious conflicts and errors in the records, but also gave the author an invaluable in-depth preception of the written word.

(U) GLOSSARY OF ABBREVIATIONS

ABL--Allegany Ballistics Laboratory
ABMA--Army Ballistic Missile Agency
Abn--Airborne
ACofOrd--Assistant Chief of Ordnance
ACofS--Assistant Chief of Staff
Act--Acting
Actv--Activity, Activate
Admin--Administrate, Administrative, Administration
A&GM--Artillery & Guided Missile
Agrmt--Agreement
AMC--Army Materiel Command
AMCTCM--Army Materiel Command Technical Committee Minutes
Amdt--Amendment
AMICOM--Army Missile Command
AMOCOM--Army Mobility Command
AMP--Army Materiel Plan
AMSC--Army Missile Support Command
AOMC--Army Ordnance Missile Command
APG--Aberdeen Proving Ground
Appr--Approve, Approval
AR--Army Regulation
ARGMA--Army Rocket and Guided Missile Agency
Ars--Arsenal
Arty--Artillery
Asg--Assignment
ASP--Annual Service Practice
ASPR--Armed Services Procurement Regulation
Assoc--Associate (-d)
Asst--Assist, Assistant
Awd--Award

BAA--Battery Assembly Area
Bd--Board
Bln--Balloon
Bn--Battalion
Br--Branch
BRL--Ballistic Research Laboratories
Btwn--Between

Cal--Caliber
Cen--Center
CG--Commanding General
C.G.--Center of Gravity
Char--Characteristics
Chf--Chief
Chmn--Chairman

CINCUSARPAC--Commander-in-Chief, United States Army, Pacific
Cir--Circular
Civ--Civilian
Clas--Classify, Classification
Cmdty--Commodity
Cml--Chemical
CmlC--Chemical Corps
Cmt--Comment
CO--Commanding Officer
COA--Comptroller of the Army
CofOrd--Chief of Ordnance
Col--Colonel
Com--Committee
Comd--Command
Comdr--Commander
COMP--Charlotte Ordnance Missile Plant
Comp--Component
Compt--Comptroller
CONARC--Continental Army Command
Cond--Condition (-al)
Conf--Conference
Contr--Contract, Contractor
CONUS--Continental United States
Coord--Coordination
Corp--Corporation
CofS--Chief of Staff
CP--Command Post
CPE--Circular Probable Error
CPFF--Cost-Plus-Fixed-Fee
CRD--Chief or Research and Development
CSigO--Chief Signal Officer
CY--Calendar Year

DA--Department of the Army
DAC--Douglas Aircraft Company
DAGO--Department of the Army General Order
DCG--Deputy Commanding General
DCSLOG--Deputy Chief of Staff for Logistics
Def--Defense
Defn--Deficiency
Dept--Department
Detm--Determine
Dev--Development
DF--Disposition Form
Dir--Director
Dist--District
Div--Division
Dlvry--Delivery

DOD--Department of Defense
D/P&P--Directorate, Procurement and Production

ECO--Engineering Change Order
ECR--Engineering Change Request
Elect--Electronics
Engr--Engineer, Engineering
Equip--Equipment
ESCL--Evans Signal Corps Laboratory
Est--Estimate, Estimated
Estb--Establish, Establishment
E-U--Engineer-User
Eval--Evaluate, Evaluation
Exec--Executive

F--Fahrenheit
FA--Field Artillery
Fab--Fabrication
Feas--Feasibility
FFP--Firm Fixed Price
Fld--Field
FM--Field Manual
FONECON--Telephone Conversation
FRC--Federal Records Center
FS--Feasibility Study
FY--Fiscal Year

GAO--General Accounting Office
Gen--General
GHE--Ground Handling Equipment
GM--Guided Missile
GO--General Order
Govt--Government

Hdlg--Handling
HE--High Explosive
Hel--Helicopter
Hist--History, Historical
HJ--Honest John
HJ Jr.--Honest John Junior
HJ Sr.--Honest John Senior
HTL--Helicopter Transportable Launcher
HTS--Helicopter-Transportable System
HU--Handling Unit

Imprv--Improved, Improvement
Incl--Include, Inclosure
Ind--Indorsement, Industrial

Inf--Infantry
Insp--Inspect, Inspection
Instl--Installation
Instr--Instruction, Instructor
Intvw--Interview
Inv--Inventory
Inves--Investigate, Investigation

Jato--Jet-Assisted-Take-Off
Jr--Junior
Just--Justification

LAA--Los Angeles Area
LCS--Land Combat Systems
LAOD--Los Angeles Ordnance District
Lchg--Launching
Lchr--Launcher
LJ--Littlejohn
LP--Limited Production
Ltr--Letter
Ltwt--Lightweight

M--Model
Maint--Maintain, Maintenance
MAP--Military Assistance Program
Mat--Materiel
MC's--Military Characteristics
Meas--Measure, Measurement
Memo--Memorandum
Met--Meteorological, Meteorology
Mfg--Manufacture, Manufacturing, Manufacter
MFR--Memorandum For Record
Min--Minutes
mm--millimeter
MNPD--Missile and Nuclear Programming Data
MOCOM--Mobility Command
MS--Manuscript
Msg--Message
Msl(s)--Missile(s)
MSP--Missile System Plan
Mtd--Mounted
Mtg--Meeting
Mtr--Motor
MUCOM--Munitions Command

NATO--North Atlantic Treaty Organization
Nomen--Nomenclature
NPD--National Procurement Division

OAC--Ordnance Ammunition Center; <u>also</u> Ordnance Ammunition Command
Obj--Objective
OCAFF--Office of the Chief of Army Field Forces
OCO--Office of the Chief of Ordnance
OCofS--Office of the Chief of Staff
OCRD--Office of the Chief of Research and Development
OCSigO--Office-Chief Signal Officer
Ofc--Office
Off--Officer
OGMS--Ordnance Guided Missile School
OHF--Ordnance Historical Files
OML--Ordnance Missile Laboratories
Op--Operate, Operation, Operational
Ord--Ordnance
ORDTU--Rocket Branch, Research and Development Division, Office, Chief of Ordnance
OTAC--Ordnance Tank-Automotive Command
OTC--Ordnance Training Command
OTCM--Ordnance Trchnical Committee Minutes
OWC--Ordnance Weapons Command

PA--Picatinny Arsenal
P&C--Purchasing and Contracting
PE--Probable Error
PED--Program Execution Directive
PEMA--Procurement of Equipment and Missiles Army
PEMA/S--Procurement of Equipment and Missiles Army/in Support of R&D
Pers--Personnel
PMS--Projects Management Staff
P&P--Procurement & Production
PR--Preliminary Request
Prelim--Preliminary
Pri--Priority
Proc--Procurement
Prog--Program, Progress
Proj--Project
Pur--Purchase

Qty--Quantity

RAD--Research and Development
R&D--Research & Development
Rd--Round
RDB--Research & Development Board
RDTE--Research, Development, Test, and Evaluation
R&E--Research & Engineering
Recm--Recommend
Recmn--Recommendation

Rel--Release
Rep--Representative
Rept--Report
Req--Request
Resp--Responsible, Responsibility
RHA--Records Holding Area
RIA--Rock Island Arsenal
Rkt--Rocket
ROE--Resident Ordnance Engineer
ROO--Resident Ordnance Officer
ROO-LAA--Redstone Ordnance Office, Los Angeles Area
RROE--Redstone Resident Ordnance Engineer
RSA--Redstone Arsenal
RSIC--Redstone Scientific Information Center

S&M--Supply and Maintenance
Scd--Schedule
SCEL--Signal Corps Engineering Laboratories
Sch--School
Sec--Section
Secy--Secretary
SigC--Signal Corps
SLOD--St. Louis Ordnance District
SNL--Standard Nomenclature List
SO--Special Order
Sr--Senior
SS--Summary Sheet
Stmt--Statement
STRAF--Strategic Army Force
Sub--Subject
Subcom--Subcommittee
Sug--Suggest, Suggestion
Sum--Summary
Suppl--Supplement, Supplemental
Sur--Surface
Svc--Service
SXR--Senior ARGMA Representative
Sys--System

T&E--Technical & Engineering
Tech--Technical
TIR--Technical Information Report
Tlr--Trailer
Tng--Training
TR--Technical Report
Trans--Transport
Transbl--Transportable
Trf--Transfer
Trk--Truck

TT--Teletype

USA--United States Army
USAAA--United States Army Audit Agency
USAAEBD--United States Army Airborne and Electronics Board
USAARTYBD--United States Army Artillery Board
USAREUR--United States Army, Europe
USARPAC--United States Army, Pacific
USMAAG--United States Military Assistance Advisory Group

Vol--Volume

WA--Watertown Arsenal
WECOM--Weapons Command
WO--Work Order
Wpn(s)--Weapon(s)
WSMR--White Sands Missile Range
WSP--Weapon System Plan
WSPG--White Sands Proving Ground
WSSCA--White Sands Signal Corps Agency

XM--Experimental Model

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